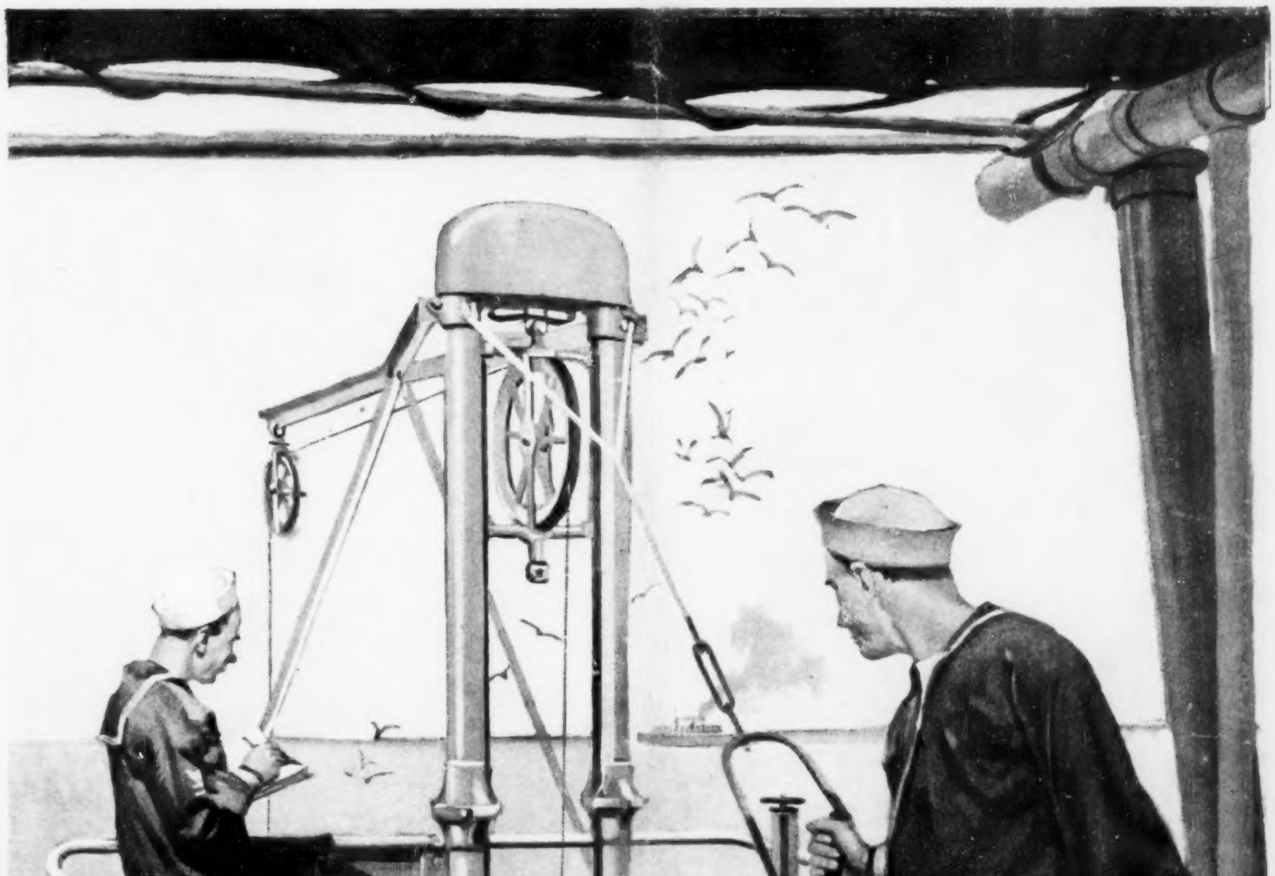
IN THIS ISSUE: AUTOMOTIVE MILESTONES
WHERE IS THAT RATTLE?

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



EXPLORING THE OCEAN BOTTOM WITH THE DEEP-SEA SOUNDING EQUIPMENT.—[See page 10]

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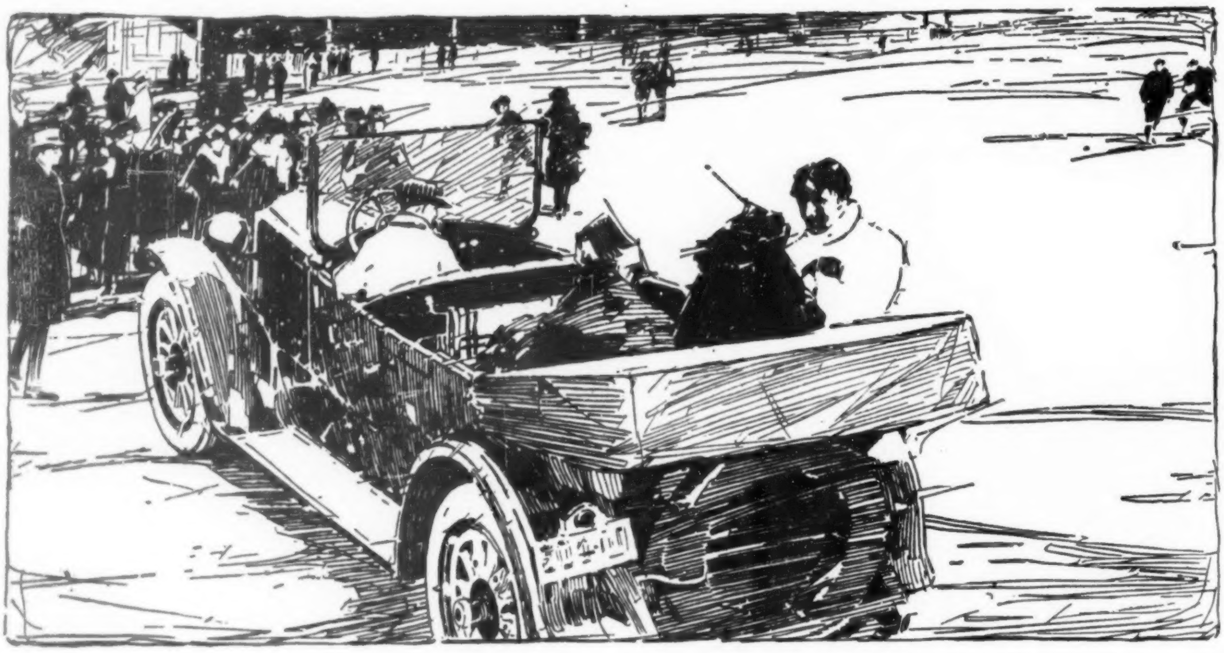
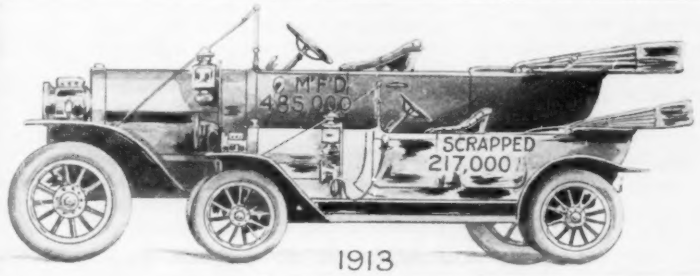


SEVENTY-SEVENTH YEAR

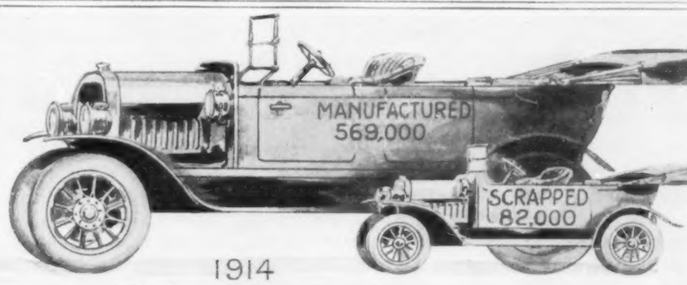
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

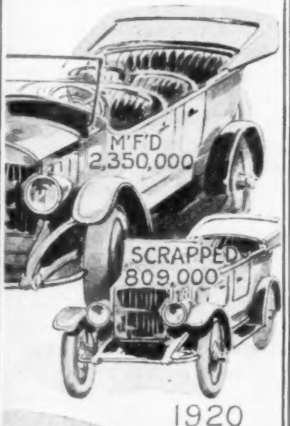
VOLUME CXXIV. NUMBER 1 | NEW YORK, JANUARY 1, 1921 | 15 CENTS A COPY 20 CENTS IN CANADA



1913



1914

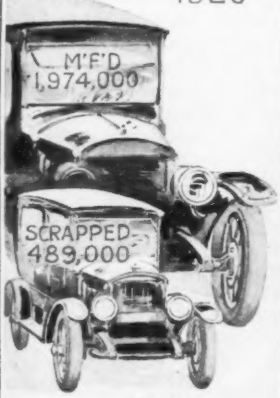


1920

1915

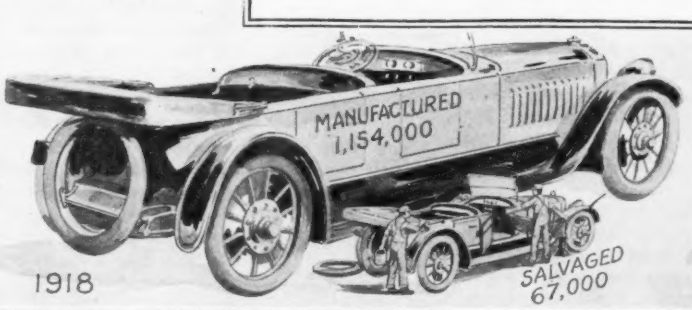
	For the year			Total 1899 to year named			Total put in service in United States up to year named	Registration for the year	Total cars eliminated up to year named	Cars eliminated in year named
	Manufactured	Imported	Exported	Manufactured	Imported	Exported				
1899	3,700	....	....	3,700	....	.....	3,700	....	......	......
1900	4,800	....	....	8,500	....	.....	8,500	....	......	......
1901	6,300	....	....	14,800	....	.....	14,800	....	......	......
1902	8,300	....	....	23,100	....	.....	23,100	....	......	......
1903	11,000	....	....	34,100	....	.....	34,100	....	......	......
1904	21,975	....	....	56,075	.....	.....	56,075	....	......	......
1905	25,000	....	....	81,075	....	.....	81,075	....	......	......
1906	34,000	....	....	115,075	....	.....	115,075	....	......	......
1907	44,000	....	....	159,075	....	.....	159,075	....	......	......
1908	65,000	1,045	3,000	224,075	1,045	3,000	222,120	....	......	......
1909	127,731	1,624	6,000	351,906	2,669	9,000	345,475	....	......	......
1910	187,000	1,473	9,000	538,806	4,142	18,000	524,948	....	......	......
1911	210,000	888	10,000	748,806	5,030	28,000	725,836	....	......	......
1912	378,000	963	18,000	1,126,806	5,993	46,000	1,086,729	1,009,513	77,286	......
1913	485,000	748	25,286	1,611,806	6,741	71,286	1,547,261	1,253,034	294,227	216,941
1914	569,045	300	29,090	2,180,851	7,041	100,376	2,087,516	1,711,339	376,177	81,950
1915	892,618	322	37,876	3,073,469	7,363	138,252	2,942,570	2,445,664	496,906	120,729
1916	1,583,617	1,474	77,499	4,657,086	8,837	215,751	4,450,172	3,512,996	937,176	440,270
1917	1,868,947	105	80,779	6,526,033	8,942	296,530	6,238,445	4,983,340	1,255,105	317,929
1918	1,153,637	50	47,244	7,679,670	8,992	343,774	7,334,888	6,146,617	1,188,271	*66,834*
1919	1,974,016	117	82,730	9,653,686	9,109	426,504	9,236,291	7,558,848	1,677,443	489,172
1920	2,350,000	200	100,000	12,003,686	9,309	526,504	11,486,491	9,000,000	2,486,491	809,048

THE production figures for 1899, 1904, 1909 and 1914 are from the Federal Census; for 1917 and 1918 from the manufacturers' sworn statements to the War Industries Board; for 1900, 1901 and 1902 they are estimated by the SCIENTIFIC AMERICAN on the basis of a constant percentage of annual growth between 1899 and 1903; for 1920 the best estimate available has been used and for all other years the figures compiled by the National Automobile Chamber of Commerce. All import figures to 1919, and all export figures from 1913 to 1919 inclusive, are those of the Bureau of Foreign and Domestic Commerce. For 1920 the SCIENTIFIC AMERICAN has estimated both these items, the former on the assumption of a percentage of increase identical with that of 1919, the latter on the basis of uniform percentage of production as against 1919. The imports for 1908 to 1912 are likewise estimated by the SCIENTIFIC AMERICAN on the basis of a substantially constant percentage of the annual production, as indicated by the export figures for 1913 and 1914. The registration figures are those of the National Automobile Chamber of Commerce, except that for 1920, which is again an independent estimate, but which if anything is too low. All figures are for passenger cars and trucks combined, but do not include motorcycles or tractors.

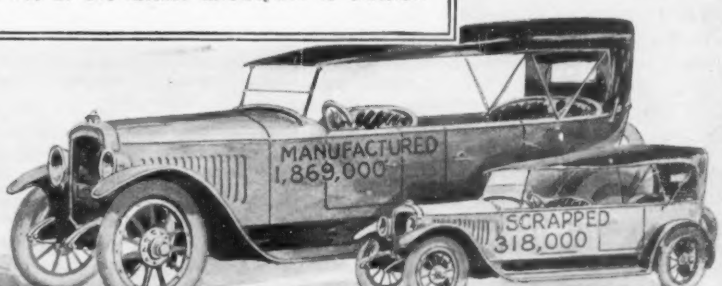


1919

1916



1918



1917

The above table shows at a glance the status of automobile manufacture and use in the United States, from the very beginning, so far as figures are available or can be reasonably estimated. The manner in which the figures in the later columns are obtained and those from the earlier will be plain from examination of the table. Special attention must be given the entry for 1918 in the final column, which shows that there were enough cars salvaged from the waste of previous years to create a net gain for this year of 67,000 cars, over and above all the new cars put into service. This is brought out in the graphic comparisons of the border.

THE HISTORY OF THE AMERICAN MOTOR CAR INDUSTRY TOLD GRAPHICALLY AND IN FIGURES

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Review of the Year 1920

Readjustment

TWELVE months ago, in reviewing the year just closed, we spoke of the clouds of disillusionment which lay broad and heavy upon the world, and expressed the belief that mankind had reached a stage of education and enlightenment, at which there was no reason to fear the revolution and chaos of which the more timorous souls among us were fearful. The intervening twelve months since that was written have justified our optimism; for there are many signs that a process of readjustment, slow it may be, but steady, has been taking place. We say this even in the presence of the trying period of diminishing production, shrinking trade and headlong fall in prices through which the country is passing. It is a healthy blood-letting. That the country should endure so quietly a crisis which in any earlier period of its history would have brought a catastrophic collapse is immensely reassuring. The fundamental law of supply and demand is asserting itself with unexpectedly swift results, and we are among those who believe that the new year will not have run its course very far before this old world of ours will realize that industrially, socially and politically, it is getting back into its stride.

Engineering

Although the world is still suffering from the stupefying effects of the great war, notable work has been done in the broad field of engineering. Our railroads, now under private control, are setting their house in order—a task of no little magnitude. Effort is being directed to making good the depreciation both in roadbed and rolling stock, and such new methods of operation as were tried during the war and found to be of value are being applied, with modifications, under private ownership.

That notable waterway, the New York State Barge Canal, has been maintained at its full depth during the year. The construction of terminal grain elevators and local and terminal docks, and their equipment with the latest freight-handling appliances have been pushed through as far as appropriations would allow. Several private companies have been formed for the construction of fleets of barges. The Canal has shown that it can carry freight cheaper than the railroads, and in less time between given points. The pressing needs of the Canal are that the Government should give up Federal operation of barges, and that a well-ordered campaign of education should be set on foot to place the superior advantages of shipment by canal before the general public.

Work on the Panama Canal has been directed mainly to the finishing up of the very fine terminal works, both on the Atlantic and the Pacific, and the removal of material which has moved in from the slides, big and little. The Culebra slides are showing decreasing activity as the material reaches its natural angle of repose, and, so far as this difficulty is concerned, shipping has now unobstructed passage. There has been a steady growth in traffic, and the receipts from tolls now exceed the cost of maintenance and operation.

The ambitious proposal to construct a deep-water route between the Great Lakes and the sea by way of the St. Lawrence River has been to the fore this year. The Canadians are deepening the Welland Canal to 30 feet, and the stretch of the St. Lawrence from Lake Ontario to Montreal is to be canalized and deepened so as to permit ocean-going craft to pass from the Lakes to the Atlantic. Because of the joint ownership of the St. Lawrence, it is probable that if this enterprise be put through it will be by the combined efforts of the United States and Canada.

More than ever throughout the world are attention and effort being directed to the matter of irrigation and the development of waterpower. Here in the United States the good work goes on apace. It is realized, however, that if we are to develop our abundant waterpower economically, we must coördinate the separate existing plants and those that have yet to be built into certain great systems covering and serving definite areas of the country. A plan which is receiving much attention covers the states lying between the Alleghenies and the coast, and between the St. Lawrence and the Susquehanna Rivers. Not alone are the waterpowers to be developed, but there will be certain great coordinated central steam electric stations suitably located with regard to the mines and transportation.

A noteworthy event in the history of urban transportation was the inauguration of work on the vehicular tunnel beneath the Hudson River, which is to consist of two cast-iron tubes, each 29 feet in diameter. Each tube will consist of three sections, an upper and lower air duct and a central section devoted to traffic. No constructional difficulties are expected. The main problem, of course, is to provide for effective ventilation. It is expected that the plan adopted will completely change the air, if necessary, 32 times an hour. The estimated cost is $22,262,000 and the time for construction is set down at three and one-half years.

An important and gratifying movement of the year was the revival of interest in the scheme for a bridge across the North River. Preliminary steps have been taken to finance this great project, which, with its distributing yard in Jersey City, its terminal station in Manhattan and its elevated marginal freight railway to the Battery, will cost 200 million dollars. All of the trunk railroads will make use of the system, and the funds for its construction are in sight.

One of the stupendous problems of the future will be to provide rapid transit for the teeming multitudes of our largest cities. A recent official report shows that the travel in New York increased from 1,527,000,000 in 1910 to 2,400,000,000 in 1920; and it is predicted that there will be five billions in 1945, and over nine billions in 1995. To take care of this, the present length of tracks must be increased from 616 miles to 1,446 miles, and the tunnels from the present 34 to 76.

Naval

Because of the fact that outside of Japan we are the only nation which is doing any warship construction on an extensive scale, the record of new naval work is necessarily confined pretty much to ourselves. Japan is doing some shipbuilding, but she is making known practically nothing about it, other than a bare statement of her program, which aims at what they call an 8-8 standard. That is, she is building with a view to having two fleets embodying eight of the latest dreadnaughts in each, with a fleet of eight battle cruisers. At present she has five dreadnaughts built and three building, and four battle cruisers completed and four building. A comparison with our own dreadnaught fleet shows how great is our preponderance of strength. We have seventeen dreadnaughts completed, all of which are in commission, and we have seventeen under construction. If the "South Carolina" and the "Michigan," each carrying eight 12-inch guns, and of 18-20 knot speed, be included, we have nineteen dreadnaughts completed and in commission. Our total strength, then, in ships built and building, is 34 or 36 dreadnaughts. In destroyers we are exceedingly strong, having a total of 235 completed and 70 under construction and authorized. Our fleet is poorly balanced. Its glaring defect is the total absence of battle cruisers. Six of these have been authorized and a little work has been done upon them. They should be completed, or better, four of them should be completed as battle cruisers and the other two should be redesigned as airplane carriers. Another defect is our lack of fast scouts or light cruisers. We have ten under construction, which should be completed. We need also flotilla leaders, of which we have none. Congress is going to cut heavily into the naval appropriation. Since we are so strong in battleships and so lacking in battle cruisers, scouts and flotilla leaders, we should cease work for the present upon the six huge battleships of 43,000 tons which will cost fully 40 million dollars apiece. They can wait.

The need for going slow on new construction, especially of capital ships, is the more apparent when we remember that the European nations, including Great Britain, have laid down no capital ships and practically no warships of any kind for the past two years. Partly is this due to financial stringency, but unquestionably, at least in the case of Great Britain, it is due also to the recognition of the formidable part which war in the air is destined to play in future naval warfare, particularly as a means of attack with large masses of explosive carried to the battleship in the form of close-up torpedo attack or the delivery of deck-piercing bombs carrying enormous charges.

Merchant Marine

The past twelve months have witnessed a steady growth of our merchant marine. True it is that the total tonnage under construction has decreased from 3,470,748 tons in 1919 to 1,772,193 tons in 1920; but this was mainly due to the completion of the Shipping Board building program. Before the war we owned 2,027,000 tons—today the total is 12,406,000 tons. The United Kingdom has about made good the ravages of the war; her merchant fleet now amounts to 18,111,000 tons, or, including the Dominions, 20,143,000 tons. Construction of new shipping is bound to be modified by the rapid fall in freight rates and the decline in deep sea traffic. At the end of September, 1920, a total of 3,731,098 gross tons was under construction in British yards, and 1,772,193 gross tons was being built in the yards of the United States. Construction in the other most active countries was as follows: Holland, 423,400 tons; Italy, 365,313 tons, and Japan, 262,407 tons. The Congressional investigation of the Shipping Board has confirmed experienced shipping men in the belief that the sooner our new fleet is taken out of the hands of the Board and entrusted to shipping companies of experience and standing, the better for the future of the American merchant marine. The ships should be sold to the highest bidder for private operation.

Closely associated with the future of our merchant marine is the question of suitable terminal facilities at our leading ports, and notably, at New York, through which passes fifty per cent of the sea-borne traffic of the country. It is a matter of common knowledge that our port facilities, both as to docks, piers and freight handling equipment, are in many respects far from conforming to the best up-to-date practise in foreign ports. New York is building a new terminal at Staten Island with twelve new piers from 1,000 to 1,110 feet in length and from 125 feet to 209 feet in width. The Dock Department is planning also to rebuild some 32 old piers on the Hudson River waterfront.

The technical improvements of the year include an increasing substitution of oil fuel for coal. The "Olympic" and the "Aquitania" are now oil burners. They can take on 6,000 tons of oil in six hours, whereas formerly it took four days to coal. On the "Aquitania" the firemen force was reduced 70 per cent. There is no disposition to build ships of the size of the "Aquitania" and the "Leviathan." A tonnage of twenty-five thousand and a speed of eighteen knots seem to meet the needs of the shipping companies of today. A noteworthy fact is the application of the electric drive to the merchant marine; the freighter "Eclipse" and the passenger ship "Cuba" were both equipped with this motive power during the year. The heavy oil engine is established as an economical and thoroughly successful drive for freight ships, and there is a steady increase in the size of the installations, as witness the "Africa," built this year at Copenhagen, of 14,000 tons capacity and driven by Diesel engines of 4,500 horse-power.

Aeronautics

To those of us who looked for a rapid development of commercial aviation following the close of the war, the past year will be something of a disappointment. On the other hand, there have been certain develop-

ments both here and abroad of encouraging significance. In Europe, not only have the established passenger routes functioned with regularity and safety, but there has been a growth in air travel which has been full of promise. To the airplane industry as a whole the most important event of the year was the appropriation by Congress of over one million dollars for a service to be operated by the Post Office Department from New York City by way of Cleveland, Chicago and Omaha to San Francisco. Other Post Office routes determined upon were Cleveland-Detroit, 95 miles; Pittsburgh-St. Louis, 600 miles; New York-Pittsburgh-Chicago, 735 miles, and New York-Atlanta, 815 miles. This move of the Post Office will call for a large and steady output of airplanes. Government assistance in promoting the new art was seen in the offer of the British Air Ministry of $320,000 in prizes for the best airplanes and seaplanes. Because the advancement shown in the competing planes was much less radical than the Ministry had hoped, only $160,000 was awarded. The monoplane seems to be again coming into its own, and metal construction promises ultimately to replace the present wood, wire and canvas. In June of last year, an all-metal monoplane made a non-stop flight of 1,400 miles, and in Germany an all-metal monoplane has carried eight passengers to a height of 22,000 feet. Another promising development is the use of multiple-engined planes with the units so connected up that any one of them may be thrown temporarily out of gear for repairs. With a view to enabling high-speed machines to land at low speed, attempts have been made to produce variable-camber and variable-surface wings. A variable-camber wing was used by the Dayton racing monoplane at the Gordon Bennet races this year. The French have tested with gratifying results a variable-surface wing in a machine which combines a maximum speed of 125 miles an hour with a landing speed of slightly over 30 miles. Another device designed to assist the difficulties of landing high-speed planes is the reversible propeller, successful tests of which were made at the McCook Army Flying Field.

Two notable speed tests run off during the year were the race for the Gordon Bennett Cup in France and the race in this country for the Pulitzer trophy. The former race was won by a Nieuport biplane with a 300-horse-power Hispano Suiza, which covered 186.45 miles at a speed of 168.4 miles per hour. The three American high-powered machines entered suffered breakdowns; but in the contest at Mineola for the Pulitzer trophy, the Verville-Packard Army biplane, driven by a 600-horse-power Liberty motor, won at a speed of 178 miles and subsequently in a speed test reached a speed for one mile of 183 miles per hour. The world's record for one mile is held by de Romanet, who drove his Nieuport at a speed of 191 miles per hour.

Pure Science

As usual, we feel impelled to apologize for the large place which astronomy occupies in our vision of the field of pure science; and, as usual, we must account for this on the ground that so many sciences that used to be pure are now sufficiently defiled by practical application to demand listing under the headings "Electricity" or "Industrial Progress." The outstanding astronomical item of the year was doubtless Professor Michelson's ingenious apparatus for so splitting up and identifying the light from the separate components of multiple stars that we shall shortly have a fund of data as to the sizes, mutual distances and periods, etc., of these objects, which a year ago might have seemed permanently beyond our reach.

On the whole, the astronomical development of the year has displayed remarkable unity. This is fast becoming a statistical science. The Lick observatory is making a "census" of the nebulae, and estimates that it will list between 700,000 and 800,000 of them. Kapteyn's remarkable investigations into the distribution of the stars in space, the extent of starry space itself, etc., are another case in point. Everywhere we turn in the world of the astronomer we find him collating thousands of observations, carrying out complex problems in probabilities, falling more and more definitely back upon the resources of the statistician. It doesn't sound as though it would make astronomy more interesting, but the results are of such paramount importance that we can surely make this statement.

When we look over the field of physical science for the outstanding achievement of the year we find nothing that is clearly entitled to that rank, but many items which demand mention. More or less tied up with electrical science is the photographic recording of heart beats, holding promise of a highly valued method of diagnosis. Our physicists display a marked tendency to take investigations into sound more seriously than ever before. They are photographing sound waves with the result that they know much more about them than they did; they are using sound as a means of measuring the depth of water; they are using sound as a substitute for sight in enabling the blind to read from ordinary type by means of the optophone which, of course, is not yet on a commercial basis. The method of measuring by light interference-bands has been extended during 1920 to the screw thread, always a tough nut for the precision man, and to bar deflection.

A fundamental scientific theory formulated during the past year and of vital importance if it stands up is that of Dr. Langmuir on the structure of matter. More or less in the same field of electro-chemistry is the work on prevention of rust at high temperatures which has been brought within 1920 to commercial application. An important war-time development brought to its climax is that of "seeing in the dark" by means of the minute heat radiation given off by human beings and objects. This is entirely in line with the modern tendency of promoting the infinitesimal to an important rôle in our scientific processes.

Two advances in the field of plant biology should be mentioned. In the United States new knowledge has been got of the part played by daylight in the promotion of plant growth, and the suggestion is that by properly proportioning the hours during which the plant is exposed to light and to darkness we shall have greatly increased yields. In Germany the double end is served, of improving the growth of the plant and disposing of an industrial waste, by the fertilization with carbon dioxide of the air above the growing crops.

Electricity

On the whole the past year has been a very successful one in the annals of electricity. Not only was there marked progress along new and promising lines, but existing ideas were applied to the utmost within the twelve months of 1920. The ever-increasing use of electricity in so many different fields obviously calls for more power and still more power, and the past year witnessed the erection of many important power plants, particularly of the hydro-electric type. Indeed, the undeveloped water power resources of the United States have been rapidly reduced to slow-moving rivers and tiny mountain streams.

With the increase in power plants, attention has again been directed to transmission problems; for it is one thing to generate the power and quite another to distribute it over a wide area. Material advances have been made in designing insulators for high-tension current—advances which must soon be realized in a practical way in the transmission of current over long distances. Slowly but surely electricity continues to make its way into the industrial world, replacing methods which have stood the test of ages. During 1920 electric heating continued to gain ground—electric steel furnaces, electric brass furnaces, electric ovens, electric paint dryers, electric high-temperature furnaces—these and many other applications grew in number.

In the field of electric lighting nothing of a spectacular nature took place. However, the opalescent bulb made its appearance in great numbers, evidently meeting with a most cordial reception at the hands of the public. Considerable laboratory work marked the progress of the electric lighting art during 1920; and certain advances were scored in the way of high-efficiency, gas-filled lamps, particularly argon lamps, of greater candle-powers, and better methods of distributing the light from such illuminants. Very material progress was made in the field of incandescent searchlights, thus bringing the searchlight within reach of many heretofore untouched applications.

Remarkable progress has been made in the X-ray field. No doubt the leading single instance of progress is the portable outfit designed by Dr. Coolidge, which brings the X-ray to the bedside of the patient whether he be in the hospital, private home, battlefield, camp or elsewhere. Meanwhile X-rays have been introduced into the workaday world for such purposes as detecting flaws in castings, locating imperfections in mica sheets intended for electrical machinery, and so on. All these applications have called for a tremendous output of tubes, and the past year has brought about the production of X-ray tubes by the thousands—a miracle in quantity production methods, since heretofore X-ray tubes were the product of skilled metal workers and glass blowers, who turned them out one by one.

The vacuum tube continued to hold a prominent place in the electrical world during 1920. Thanks to the interest taken in these tubes by the leading electric companies and their remarkable laboratories and skilled personnel, the art has forged ahead. In its wake have come important improvements in radio communication, and promising results in wired wireless. It is interesting to note that the experiments in wired wireless in 1920 gave definite promise of telephoning to Europe over the cables at a no far distant date. While dealing with radio communication, it is well to remember the many things undertaken in 1920 which must bear fruit in 1921. Among these is the huge wireless plant being erected at Port Jefferson, Long Island, which will enable New York City to communicate with stations scattered over the world. A serious attempt, moreover, has been made to introduce radio communication between several American cities. And whatever has been done in radio communication has only spurred the wire companies to still greater efforts, such as long-distance through wires, increasing the number of messages over a given set of wires by means of automatic transmitters and receivers, and so on.

Loud-speaking telephones for addressing thousands upon thousands of persons in the open and for use in noisy shops; the increased use of automatic telephones, and other features have marked a successful year for telephone enterprises. The radio cable, installed in New York Harbor, marked one of the real lessons of the war applied to useful peacetime pursuits.

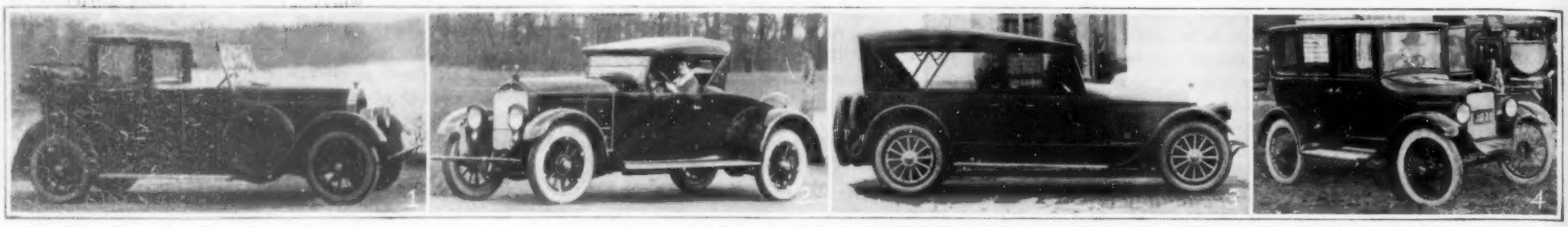
Industrial Progress

The industrial conditions of 1920 form an interesting study in extremes; the year began with a serious shortage of labor of all kinds and with the highest wages yet scored in a country known for its high wages, and ended with a business depression which was reflected in the closing down of plants on the one hand, and the reduction of high wages on the other. Indeed, in the short space of something like three months conditions were reversed; the dictation of labor had been replaced by the dictation of the employer; strikes were at an end; money, hitherto so plentiful, became scarce.

But our immediate province is more concerned with what the effect of the labor shortage was along mechanical lines, and what mechanical change took place when economic conditions reversed themselves. During labor's régime there were marked efforts to introduce all manner of labor-saving devices in order to obtain maximum output with minimum labor. Many worthwhile labor-saving appliances made their appearance, with the sanction and even recommendation of labor.

It is well to bear in mind that Europe, now rapidly recuperating from the cruel blows of the war, is getting into the business game once more and already European products are reaching our shores in ever-increasing quantities. Due to the exchange situation, European products can be sold in the United States at prices which defy American competition in certain lines, even allowing a fair margin for increased tariff. All of which must necessarily spur American manufacturers to bend every effort to reduce their production costs to the utmost.

Further conversion of war plants took place, with the spectacular sale of several of the extremely large plants built during the war for the manufacture of fighting equipment and supplies. From machine guns to sewing machines and phonographs, from steel helmets to ventilators, from time fuses to alarm clocks—these were typical of the getting-back-on-a-peace-basis movement. Meanwhile much attention was given to better transportation means. The New York State Barge Canal was put in service, with much promise of extensive employment in the immediate future. Several new canal schemes were proposed and received with considerable favor. The motor truck was used for longer hauls in preference to the rail routes.



1. An example of specially built body work of high class. 2. A good example of what its makers call "pronounced and fashionable lowness," characteristic of modern body design. 3. Long, rakish lines feature the bodies of the better cars. 4. A modern light sedan of good appearance is useful for many practical purposes

Four bodies which are representative of the latest lines in open and closed cars

The Trend of Design for 1921

A Glance at the Changes and the Continuations of Automobile Practice

By Victor W. Pagé, M.S.A.E.

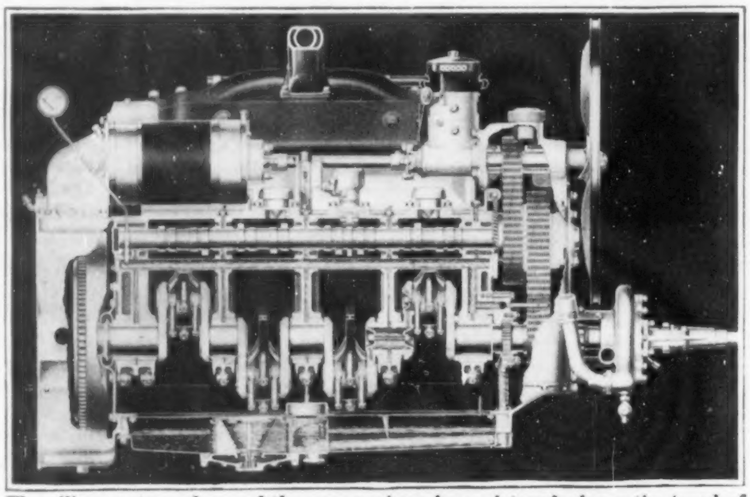
ONE who is familiar with the degree of standardization that has taken place in the American automobile industry realizes that one cannot expect to find improvements or changes of a radical nature in automobiles from year to year at the present time because the mechanism has been developed to a point of great reliability and one that is not susceptible to any change in its essentials. With few exceptions there has been no marked progress in automobile design during the past year; practically all well-known makes of cars for 1921 will embody the characteristics of the successful models which have preceded them for several years.

The tendency as a whole has been to change body lines very slightly; cars of different makes are beginning to look more and more like each other every passing year. It now takes a quick eye and an expert knowledge of the smaller points in car design to be able to identify many of the leading makes when one passes them on the road.

The low, rakish sporting or speedster type of body that was introduced several years ago is now found on practically all cars except the closed types and here again one finds a similarity in appearance, seating arrangement and general finish on all of the stock closed cars. Body makers who make a specialty of catering to people who have sufficient means to gratify their taste for the unusual have created very interesting special body designs that are quite beyond the reach of the average purchaser of automobiles.

The progress of design for 1921 is marked chiefly by attention to details and not by any changes that are apparent to the inexpert. The conditions are just what they should be in a well-developed industry that has found the need for experimentation with new models past and which realizes that much can be accomplished by improving what already gives successful service rather than by devising new designs, the utility of which may be questioned.

Considering first the power plant, we find that the six-cylinder engine is the type used by the largest number of different car-manufacturers, though it is not the most popular if judged from point of numbers because several large quantity producers of cars stick to the four-cylinder type. Two new types of eight-cylinder engines have been developed during the past year, one of which is a V or twin-four form in which the cylinders are placed at an angle of 60° instead of the usual 90° that has been formerly considered the best placing of the engine cylinders. This spacing was used successfully on a number of aviation motors and it was found that by proper attention to design the engines run with very little vibration even though the explosions in the cylinders are not separated by equal periods of time as in the V-engine with the cylinders arranged at 90°.



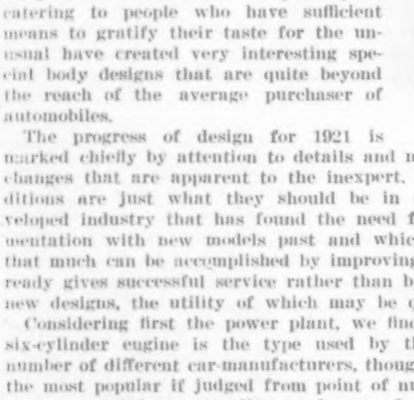
The oiling system of one of the new engines, here pictured, shows the trend of modern practice in positive pressure-feed lubrication

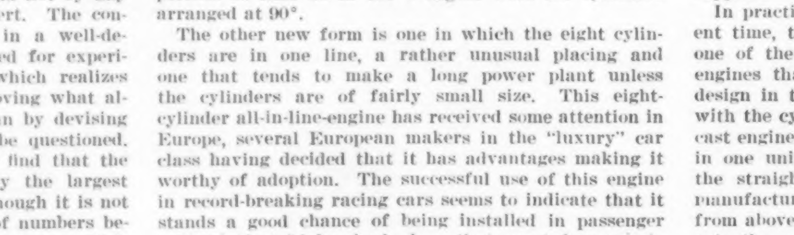
The other new form is one in which the eight cylinders are in one line, a rather unusual placing and one that tends to make a long power plant unless the cylinders are of fairly small size. This eight-cylinder all-in-line-engine has received some attention in Europe, several European makers in the "luxury" car class having decided that it has advantages making it worthy of adoption. The successful use of this engine in record-breaking racing cars seems to indicate that it stands a good chance of being installed in passenger cars of that high-priced class that must incorporate distinctive features of design in order to find a market.

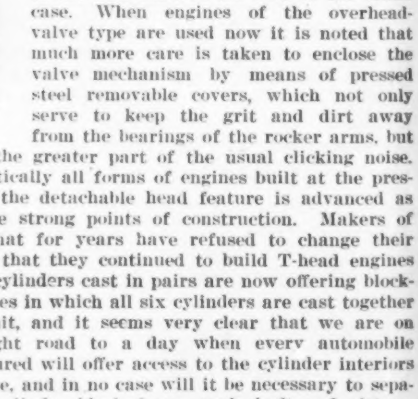
The eight-cylinder engine cannot be considered superior to the six-cylinder as regards mechanical balance, because there is a couple which tends to rock the engine in a longitudinal plane. This is because an eight-cylinder all-in-line engine may be considered merely as two four-cylinder engines placed in tandem, and owing to manufacturing difficulties the crankshaft arrangement is usually the same as though two four-cylinder crankshafts had been placed end-to-end, so that the plane of one is at 90° to that of the other. While the inertia forces in the two sets of four cylinders will occur a half-period apart and will cancel each other because they are equal and opposite in direction, this cannot prevent the rocking couple in a longitudinal plane because the forces do not act along the same line.

There has been no marked increase in the use of overhead valves nor has advantage been taken, as it has in Europe, of the experience gained in aeronautical engine construction in which overhead valves are actuated directly by an overhead crankshaft. In this country practically all of the engines in which the valves are carried in the head use rocker arms and tappet rods which extend down to the cam-shaft in the side of the crank case. When engines of the overhead-valve type are used now it is noted that much more care is taken to enclose the valve mechanism by means of pressed steel removable covers, which not only serve to keep the grit and dirt away from the bearings of the rocker arms, but suppress the greater part of the usual clicking noise.

In practically all forms of engines built at the present time, the detachable head feature is advanced as one of the strong points of construction. Makers of engines that for years have refused to change their design in that they continued to build T-head engines with the cylinders cast in pairs are now offering block-cast engines in which all six cylinders are cast together in one unit, and it seems very clear that we are on the straight road to a day when every automobile manufactured will offer access to the cylinder interiors from above, and in no case will it be necessary to separate the cylinder block from crank-shaft and pistons.







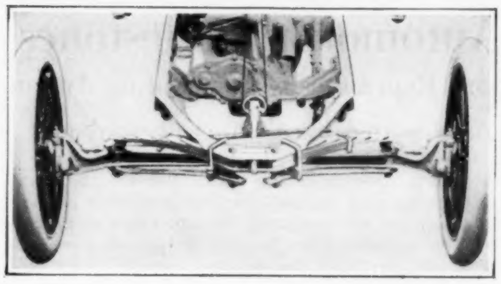
Left: The multiple disc type of clutch, which is very popular, having displaced the cone clutch in many cars. *Center:* A familiar chassis of the moderately priced group, with wheels removed to show the popular spring suspension. *Right:* A typical example of the three-speed selective sliding gear box with center control, standard on most cars

Standard practice in the driving and spring suspension members

The situation as regards aluminum pistons is the same as it has been in past years; they have not increased in popularity as much as was expected. Some makers have quietly changed over from aluminum pistons to members of cast iron without advertising the fact and others who formerly used cast-iron have installed aluminum alloy systems in the same quiet way. One maker who formerly favored aluminum pistons has adopted a compromise form in which both cast-iron and aluminum are used. Some of the defects that have been advanced against the aluminum piston by those who do not favor them have been proven to have little weight by other makers who continue to employ them successfully.

A larger number of makers are using balanced crankshafts at the present time, though there has been no change in the situation so far as size of crankshaft is concerned or the number of bearings used for its support.

The auxiliary systems are practically the same as last year excepting that more care has been taken in the new designs to provide means for vaporizing low grade fuels. One prominent maker goes so far as to fit his car with a device built into the inlet manifold which burns a small amount of fuel to give sufficient heat to insure positive vaporization of the remainder. The device is said to be remarkably efficient during cold weather, as by its use it is possible to start an engine



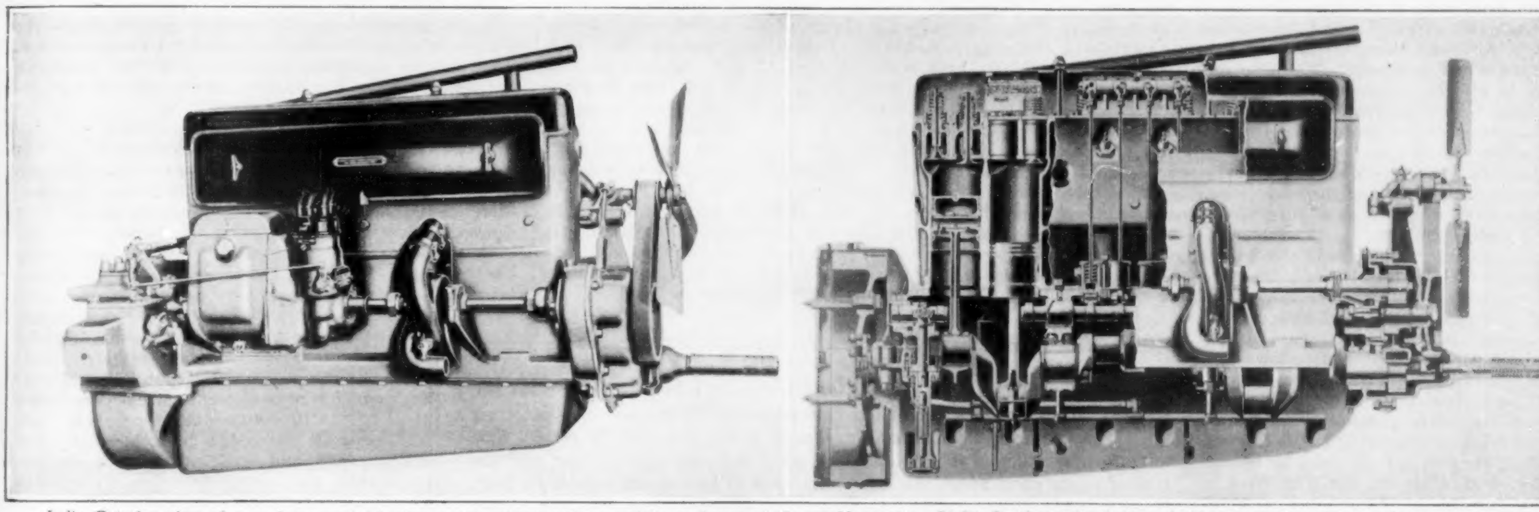
Front-spring suspension of an unusual type

form a unit power plant is more general because several makers who formerly installed the gear-box as a separate unit now find it advantageous to incorporate it with the engine by providing the gear case with a flange or bell housing which fits a corresponding member on the engine base that serves to enclose the engine flywheel. The two unit system of starting and lighting is now almost universally used and in practically all cases the starting motor is equipped with a Bendix automatic-shift pinion which meshes with a toothed gear member on the flywheel rim. The starting and lighting system units have been so well developed

asbestos-faced friction disks alternate with metal disks, the entire assembly running dry instead of in oil as was formerly necessary when the all-metal-disk types of clutch were popular. The three-speed selective type change-speed gearing with center control lever is now the most popular form, as it is found on practically all makes of cars. The four-speed gear-box is very seldom used at the present time, only a few makers of the heavier cars favoring it.

As regards the method of final drive from the rear of the change-speed gearing to the rear axle one finds the situation pretty much the same as in years past. Those who favor the Hotchkiss drive, having an open propeller shaft with universal joints at each end, still retain that construction, though some makers who formerly favored this have changed to that form where a radius or torque member is used to supplement the rear spring for resisting braking and driving torque reaction stresses. The flexible-disk universal joint in which leather- or rubber-impregnated fabric disks are used is found on an increasing number of car designs. Where the propeller shaft is carried in a torque tube or housing member having a ball joint at the front end we find that but one universal joint is used and that this is usually of the all-metal type.

For final drive gearing, the spiral bevel is applied on practically all cars, only a few of the cheapest makes now using straight tooth bevel gears. When the



Left: Exterior view of a modern overhead-valve engine, showing the complete enclosure of the working parts. *Right:* Partly sectional view of the same engine, showing the working part

The overhead-valve engine as it is worked out for 1921

promptly that has been covered with snow or ice and chilled to the point where it could not be started with the ordinary simple form of carburetor. The "fuelizer" has a spark plug which ignites the fuel supply to the heating portions as soon as the switch is turned on to start the car.

In practically all engines one finds heated manifolds to permit satisfactory evaporization of the low-grade fuel which is now being marketed at high-grade prices, and which motorists are forced to use because the rapidly increasing number of automotive vehicles makes it impossible for the oil refiner to supply adequate amounts of high-test spirit having satisfactory vaporizing qualities at even normal temperatures. As the general tendency in engine design is to core the intake manifolds or fresh gas distribution passages in the cylinder block casting and surround them with water, it does not take much time for the engine to heat up sufficiently to assist materially in vaporizing the fluid. Some engines have water-jacketed manifolds, while others have the manifold through which the intake gas passes cast integral with or at least placed in close contact to the manifold through which the hot, inert products of combustion are expelled from the engine.

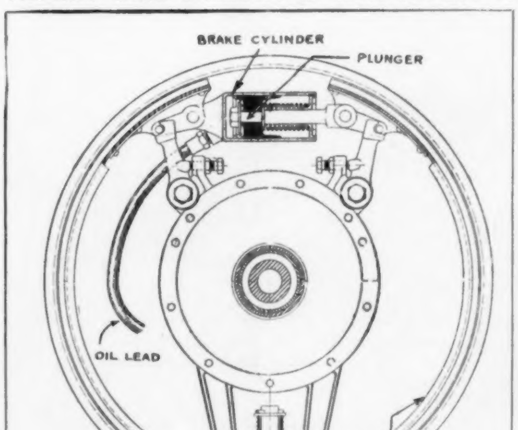
More care is noted in the design of lubrication systems and practically all engines of the better class now use the force feed method in which the oil is circulated through passages cored in the engine base casting or through suitable passages drilled in the engine crankshaft. More attention is being paid to location of the filtering screen which is placed in more accessible positions so it can be easily removed for cleaning.

Battery ignition is generally used in America for passenger cars, only one or two makes of moderate price using magneto ignition. A number of the high-priced cars, however, are supplied with the high tension magneto, but their number is so few that it is safe to say that battery and coil ignition in its various forms now controls the situation.

The mounting of the engine, clutch and gear box to

that the average motorist never experiences any trouble with them, barring a "short" in the wiring.

The most popular form of clutch, if considered from the viewpoint of numbers produced and used, is that form known as the three-plate type, in which a single disk is clamped between the flywheel web and an outer pressure member which is brought into contact with the floating plate by means of spring actuated levers. The cone type of clutch is gradually being superseded by the disk type. On most of the medium and high grade cars one finds remarkably efficient direct-drive clutch mechanism in which a series of



Novel brake mechanism that works on the newly discovered fluid-pressure transmission principle

spiral-bevel gear was first introduced it could be manufactured only by costly processes and naturally its use was restricted to those makers who could pay the price for the quieter and more enduring gears. The rapid recognition of the merit of this form of final drive resulted in an augmenting demand, which in turn was responsible for the development of special machinery for turning out spiral bevel-gearing of excellent quality in an economical manner. It is for this reason that we find the spiral-bevel gear almost universally used in this country. The perfection of this method of final drive has practically eliminated the worm gear in passenger vehicles except a few cars propelled by electric power. The worm gear, however, remains very popular in motor truck construction because it is the only form of final-drive gearing that it is practical to use with which the low final-drive reduction needed in truck construction can be obtained with a single pair of gears.

Brake design and rear-axle construction have changed but slightly. The semi-floating type of axle is now the most popular form and full floating axles are found only on a few makes of cars. There seems to be more general application of the transmission brake for emergency purposes, though on most cars using stock axles one finds the conventional internal and external brake-band assembly acting on each rear hub. In a new high-grade car just announced for the 1921 season all wheels are provided with brakes, the front as well as the rear. In this car the brakes are actuated by hydraulic cylinders of compact form and small size which are placed between the two halves of the open end of the brake band. The method of transmitting motion employed is a modification of the well-known C-C gear which was used during the past war on airplanes so that the machine-gun placed at a point where the pilot could not operate the trigger in the customary way could be actuated by a small hydraulic plunger in a suitable cylinder. A master cylinder is

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Automotive Milestones

A Digest of the Opinions Expressed by the Leading Automobile Manufacturers

As Reported by Austin C. Lescarboura

It seems desirable, at more or less regular intervals, that an art like the automotive one should have pause for the purpose of considering just where it stands and whither it is bound. At the present time there are plenty of questions connected with the manufacture and use of motor cars, which are sufficiently open to furnish the vehicle for such an introspection. The SCIENTIFIC AMERICAN *has accordingly put seven of these questions to fifty manufacturing engineers prominent in America's automobile industry; and the article on this page embodies the editorial effort to digest the replies received, and to present the consensus of responsible opinion which they represent.*—THE EDITOR.

THE automobile industry, after just passing through a period of almost unbelievable prosperity, is now taking an inventory of itself—and of the future. New conditions have brought about new demands, which must be met if the industry is to forge ahead. Just what these conditions are and how the automotive industry purposes to meet them are matters of prime interest to automobile owner and non-owner alike; for the automobile of today is everybody's vehicle, playing a prominent rôle in the daily life of the entire community.

To begin with, automotive engineers are agreed that the passenger automobile has passed through its experimental stage and reached the period of comparative stability in performance and design. Great advances will still be made in many details, but until some new and revolutionary discovery or invention appears, it is generally believed that we may expect these developments to be along the lines already laid down.

On the other hand, the passenger car is only beginning to render to civilization the service which may confidently be expected of it within the next decade or two. Although there are already nearly eight million cars in use in America, the field of service ahead of us is almost limitless. The passenger car will, within the next few years, bring about a vast relief in the congestion of our large cities by permitting people of all classes to live in the country and use their cars in going to and from work. The motor car will be increasingly used in making farm life tolerable and more profitable; it will give extended service along the lines it is already rendering to salesmen and men whose work takes them far and wide about the city and country; and it will come to be an indispensable servant of the household as well as of the worker, so that we shall find many families which are now content with one car, using two or three.

So much for these optimistic views concerning the future of the passenger car, which have proved to be quite representative of the entire automobile fraternity. But how about our roads? It has already been said that in certain sections of our country, particularly in the Far West, a further increase in the number of automobiles must await more and better roads. It is quite obvious that good roads must precede the increased use of automobiles.

The Highways and Byways of the Nation

The consensus of opinion among automotive authorities is that since transportation is one of the most vital essentials of our daily life, all good roads movements should not in any way be discouraged. The United States has not done so well in the matter of good roads as might be hoped for, considering our wealth and natural resources and volume of automobile traffic as compared with other nations. Still, the good roads question is receiving careful attention at the hands of State and Federal authorities alike. Big educational campaigns are under way with telling results. Some automotive experts strongly urge a close coöperation between Federal road action and a local action. They also urge better trunk lines, so to speak, over good roads passing east and west to both coasts, and north and south from central locations on the two borders. At least one automobile engineer comes forth with the suggestion that we are at a period when double-tracked roads must be given serious thought, in order to permit two-way traffic at higher speeds than at present and with less danger of accident.

Of course, good roads mean everything to the automobile. Good roads mean more cars in use, better facilities to everyone in cities and rural districts alike, a lowering in the cost of living because of increased transportation facilities, and longer life and lower operating costs for all cars. Still, even automobile enthusiasts, while advocating better roads, caution against the expenditure of extremely large sums of State and Federal moneys alike, at a time when taxation is already a serious burden to business and individuals alike. Whatever moneys are available should be spent where they will do the most good.

And now we come to the matter of low-grade gasoline. Time was when gasoline could be bought at any gas station of such quality that it would rapidly evaporate if left standing in the open. But the heavy demands made upon the refiners have gradually lowered the quality of gasoline used by motorists, necessitating certain provisions in the design of most engines.

Meeting the Lower Grades of Gasoline

Automobile engineers have certainly faced the fuel problem unflinchingly, realizing that the problem was not only here to stay, but might become more acute as time goes on. Varied have been the ways to meet the fuel situation. For instance, the engineers of a leading automobile company invented a device known as the fuelizer, which was introduced in their car last spring. This device, by superheating a part of the flow of gas from the carburetor, insures almost perfect combustion of the fuel, making it possible to operate economically and efficiently any engine thus equipped, with the present lower grades of gasoline.

Other engineers have met the fuel problem through improvement in the design of the combustion chamber and intake manifold. Others are experimenting with exhaust heat with the idea of utilizing this heat to vaporize lower grade fuels, and in this way increase the overall fuel economy of their cars. Electric vaporizers are being installed in certain cars for the purpose of facilitating starting in cold weather, with present-day fuels. Still another idea which is being applied is to give each part of the intake manifold a special curve, so that gasoline does not collect in odd corners, get into the crankcase, and cause loss of power in general. Hot spots and vaporizing elbows are being introduced by other engineers. Certain it is that carburetor manufacturers have assisted in these improvements in every way possible, for the good of the industry at large.

It appears that the engineers of the air-cooled type of car have been less affected by low-grade fuels than many other cars where the jacket loss is greater and where there is less heat efficiency inside the cylinders. This is due to the operating temperature of the air-cooled car. Yet these engineers, not content with their initial advantage, have worked on a baffle-plate heater on the intake manifold to break up the heavier contents of present-day fuel by throwing them by centrifugal force against heated plates where the heat serves to break up much of the fuel which would otherwise be lost.

Truly, all these improvements have done much to increase the mileage of the present cars despite the lowered quality of the fuel. Many of the medium-weight cars are making better than twenty miles on a gallon, according to the claims of their designers. Starting in cold weather has been facilitated by some of the improvements mentioned.

Just what is ahead of us in the matter of fuel is difficult to determine. Several automotive engineers hasten to assure us that we have met the lowest grade fuels which will ever be utilized for automotive purposes, while others—a very small number, to be sure—are equally emphatic in predicting kerosene, alcohol, and even crude oil. Still, the truth of the matter is that there is little to be gained in the use of still lower grades of fuel in passenger car engines. As was pointed out by the Secretary of the Petroleum Association in 1919, the demand for kerosene was such that there could not be much greater demand or the price would be equal to that of gasoline. It was the opinion of that authority that the supply of gasoline would keep pace with the demand. Almost daily new sources of oil are being discovered, which, together with new methods of refining and distilling the gasoline, should keep up the supply.

Still, it is best to be prepared, and certain automobile engineers assure us that as soon as problems affecting the distribution of other fuels besides gasoline have been solved, it will be possible, with the knowledge already in hand, to devise engines which will be entirely satisfactory with almost any fuels.

There is no indication of any wide variation from the present standard designs of gasoline engines. The problems which have limited the use of steam and electricity seem as far from solution as ever, and while it is always possible that there will be some revolutionary discovery, there is no reason to expect one. The steam and electric types have had years in which to "make good," so to speak, and apparently have failed to compete successfully with gasoline cars except in a very small and limited way. Still, they may possibly gain ground in the near future, but if they do they will find the gasoline cars also gaining ground, since the perfection of the gasoline engine and the automobile in general is by no means realized today. All in all, we are assured that the gasoline automobile is here to stay—in our day, at least.

A Word From Body Designers

It is generally believed among the automobile fraternity that the bodies have reached the point where there should be few changes in design. There will, of course, always be freak bodies and undoubtedly occasional changes in design. But since the automobile has become a factor of high economic value instead of a mere pleasure vehicle, there is no excuse for needless or faddish changes which seriously reduce the re-sale value of cars of previous models in the hands of buyers. As one body designer has put it, automobile body design is a compromise between service, practicability and appearance; but above all the bodies must be useful and practical and sufficiently strong to give service and a certain amount of protection.

The closed bodies seem to become more and more popular. Indeed, with the constantly increasing change from touring cars with the top down to the steady use of these cars with the top up, certain designers believe that the next radical change in automobile bodies will be a touring car with a permanent top which will be somewhere between the present-day type of sedan and the so-called winter top bodies. At any rate, the main object at present is to make the body as light as possible, consistent with safety and comfort of the passengers.

The matter of weight is an all-important one in present-day motoring, for the ever-increasing cost of fuel has to be compensated to some degree, and more efficient engine design cannot do it alone. Light weight is the better part of the solution. Hence one hears much about the many new alloys which are finding their way into automobile engines and other components. What is the status of this phase?

One engineer tells us that experiments are continually being made with new steel alloys and aluminum compounds; and there are indications that it will be possible shortly to reduce the weight of the cars to some extent. The application of these new materials, however, will be made in detail, and is not likely to be revolutionary at any one point. Still, manufacturers are using more alloy steel each year. Aluminum, on the other hand, is not being used to the extent of several years ago, by most builders. In fact, there is a strong block of automotive opinion which holds that aluminum is rather at a standstill than advancing as the metal for making parts for motor cars. Many engineers complain that it is too expensive. On the other hand, there are some who claim that aluminum is ideal. One engineer informs us that his company have been using considerable amounts of aluminum sheets and castings for some time, and are gradually increasing the use of this metal. So the engineering opinions as concern aluminum are pretty much divided. For bodies, however, aluminum appears to be considered with much

(*Continued on page 15*)

The Trend of Specialization

What It Does for the Modern Professional Man, and What It Takes from Him

By W. E. Vogelback, Vocational Engineer

THE study of industry is a study of organization. After many years of systematic grouping and arrangement of activities we find business emerging in the last decade as one of the major professions subdivided into a multitude of minor professions. Each of these minor professions, such as advertising, credit, management and salesmanship, has become a highly specialized science. Other major professions, particularly engineering, have followed this same trend of specialization. A century ago a man in any branch of the engineering profession was identified simply as an engineer. Fifty years ago he was a civil or mechanical or electrical engineer, while today these latter terms give but a vague idea of his qualifications or his occupation. Specialization finds its way into all industries and professions, subdividing single occupations into many, and confining the individual more and more to specific tasks.

There is an evil here to the detriment of the individual as well as to the profession. As it is, the world needs men of vision—men who are capable of big things—men who are scientists. Comparatively few men are scientists in the broader application of this term. Few men are possessed of the ability to analyze complete problems; to see the relation between the problem in its entirety, and any or all of its component factors. The individual minds of the great majority work synthetically. They grasp only that particular phase of a problem which comes under their immediate observation; one factor at a time without regard for the relation of that factor to the sum total.

Specialization does not assist in turning out these scientists—these leaders of men, but, on the contrary, materially assists in their suppression, and hence we must look elsewhere for the forces which tend to preserve this balance.

These forces will be found in our educational institutions, and our professional societies. Here, stringent requirements should be fulfilled and ethical standards should be maintained. But of these two, the greater responsibility rests upon our educational institutions.

In the short space of the usual college course today it is not expected that colleges will turn out men fully equipped for their professional practice. The aim should rather be to inculcate a method of logical reasoning; to turn out *analytical* thinkers—scientists. But I feel sure that you will agree with me, that too many men just out of college come better equipped with a collection of facts than with methods of analysis. In other words, we are turning out *synthetical* thinkers—men whose measure of comprehension of a subject is the quantity of facts they possess. I desire to emphasize this distinction between analytical and synthetical thinkers. Every individual belongs to one or the other of these classes. The class of synthetical thinkers comprises the rank and file, the detail workers, the narrow specialists. The class of analytical thinkers comprises the executives, the leaders, the planners, men of vision and foresight.

The degree of our analysis of any subject depends upon the interest we have in it. And our interest will depend upon our comprehension of the subject as a whole. If we reflect back upon these subjects in which we were most proficient in school, we will find that they were the ones in which we had the greatest interest. And probably we all recall our attitudes toward those subjects which we then seemingly knew we would never have occasion to put to practical use.

Take our large cities, centers of industry with their vast day and night educational opportunities. Would it not appear that the great majority of our successful men should be those brought up under these educational advantages? And yet as we run through the pages of "Who's Who" we observe in page after page the names of men whose education was acquired in the village school house, or small town college, or by home study. I believe these incidents are relevant and important, and that they are a natural result of a well-defined cause. This cause is the greater ratio of practical learning to the degree of specialization. In the smaller towns, industry is centralized and extensive specialization is not expedient. Here the young man entering business sees the small shoe manufacturing industry or the rice industry in its entirety. He sees the relation between the different departments and the whole plant. With the whole mechanism under one roof, so to speak, his view is comprehensive. This is impossible in the industries of our larger cities. Here, specialization has reduced the work of the individual to a mere routine. He fails to see the relation of his job to the industry. In time, perhaps, he will have held many jobs, but he will always be working under the disadvantage of lack of comprehension.

After a man has completed his college training, the evil effects of specialization as applied to him, must be stemmed by the professional organizations. Here by his association with other men in the same general profession, he extends his interests into broader fields. Perhaps the most beneficial work that can be done by a professional society, is that of maintaining appropriate standards of ethics and qualifications for membership. Here, too, is charged a large share of activity in securing appropriate license legislation. Limited preparation for the professions should be discouraged.

The big problem of today is how are we going to keep the synthetical class from growing greater in proportion to the analytical class. We see how specialization tends to confine more and more the individual to routine duties; to make of him a mere cog in the great wheel of industry. The remedy calls for a greater interest in our undertakings. The larger business institutions have come to regard this interest from the standpoint of the individual's partnership in the business. They have evolved the medium of employes organizations and house organs for educational purposes. In this way they have been able to maintain a partial balance between specialization and training.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Crossing Signal That Ought to Work

To the Editor of the SCIENTIFIC AMERICAN:

Your last issue has just come to hand and the article "Automobile Signals for Danger Spots" suggests a new kind of automobile railroad signal. It seems necessary to have a certain number of unguarded grade crossings—at least we have them with us whether it is necessary or not. As lighting laws require lights to be directed low, the signboards now in use are not always all that can be desired. Any kind of automatic signal is open to the objection that it may get out of order and has to be maintained at a considerable expense—*except one kind*. This is a device familiar to all but never used as a signal. We are all familiar with the sound of running an automobile over a wooden bridge. The racket made by the loose boards could not possibly pass unnoticed. Here we have, then, a signal for railroad crossings which cannot be unheard except by the very deaf, which can be so made that even frost and snow will not make it inoperative, and which is so simple that it cannot get out of order. And if a device of this nature were worked on experimentally to *produce noise on purpose* there is no doubt but that a very characteristic sound could be produced which would soon become so well known that it would be a 100 per cent warning. I would suggest the use of boiler plate laid loosely on the proper support as found by experiment, with board fences on either side of the road to reflect the sound, as a perfect railroad crossing signal for all traffic, horse or motor, night and day.

Montchanin, Del. E. PAUL DU PONT.

"Communication" Works Both Ways

To the Editor of the SCIENTIFIC AMERICAN:

During the past months I have read numerous articles in the SCIENTIFIC AMERICAN as well as in other esteemed journals concerning the hopes and possibilities of sending definite messages to Mars. There has been so much of this talk it would seem that some have seriously determined to make the effort. Although there are many opinions as to the best method of sending the messages, etc., there are two points upon which all agree, namely, that the cost of the apparatus and power to convey the messages would be enormous, and secondly that the Martians, if any, must be far enough advanced in learning, as much, or more so, than ourselves, to notice or interpret the messages sent, otherwise no trouble and expense would be warranted. This being admitted, why would it not be far more sensible, practical, and economical to assume that the Martians are sending messages to us, and to confine our efforts to catching their messages? If we are not clever enough to locate messages from them, why go to the enormous and very doubtful expense of trying to prove that they are our intellectual and scientific equals?

New York BAYARD S. LITCHFIELD.

A Question of Costs

To the Editor of the SCIENTIFIC AMERICAN:

The current press articles purporting to give comparative costs for hauling freight by rail and motor transport seem to me unfair, misleading, and therefore harmful when and while they omit the cost, amortization and upkeep of improved roads used by motor transport. The community pays for such roads for the benefit of motor transport, while the railroads are required to provide their own rails and roadbeds.

No doubt the community derives benefit or profit from good roads and motor transportation, but until such advantages are reduced to a ton-mile basis with proper deductions for cost and maintenance of streets and highways, all such comparisons are, as before stated, unfair and harmful.

O. H. L. WERNICKE.

Gull Point, Fla.

The Rail Cycle

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 14th, page 160, just received, you show an invention by a Frenchman, for running a cycle on the railway lines. I may say that I have a drawing before me of which I worked out the details in 1888, and the answer from the Beeston Humber Company, England, dated November 16, 1889, states they could manufacture them for me. As the price was more than I could afford to spare in those days, I did not carry out the matter commercially. A man named Hooley floated many companies later on, and some workman took, or copied, the drawing and made a crude lot in one of the branches, I think it was in Norway; later on an improved one was run by them or their late workman in Canada, and during the Boer War, a better one was used by the British troops. They all stuck to my comparatively crude drawing, but none up to the present use the rubber tires, as I worked out. Hand-propelled ones have been used on our railways for 35 years past, and now petrol motor ones supply their place. Many gangers patroling the lines have been killed by trains coming upon them from behind, because they could not hear on account of the noise they make themselves. My rubber tired ones obviate this trouble. I have been a reader of your publications since 1870 or thereabouts.

F. MÖLLER.

Adelaide, S. A.

The Detachable Broom Handle

To the Editor of the SCIENTIFIC AMERICAN:

On page 84 of the SCIENTIFIC AMERICAN, July 24, this year, is a notice of the detachable broom handle, and you say that the detachable broom handle is a brand new idea, and is taking. This was the invention of the late Mr. William Carver, of Adelaide, and was patented by him in Australia in 1896-7, and application was made for patent in England and America about the same time, and the writer found the money. During 1897 the writer brought this broom handle under the notice of two or three manufacturers in England, and also sent it to a manufacturer in Berlin, but at that time nobody seemed disposed to make any alteration in their machinery. Since Mr. Carver's death his widow has sold the patent to the Blind Asylum in Adelaide, South Australia, and these brooms are made locally by them. My firm invariably purchases the Carver detachable broom so that the invention is not quite as new as your correspondent appears to imagine. We think the late Mr. Carver ought to have the credit. And the writer would like his money back!

F. H. FAULDING.

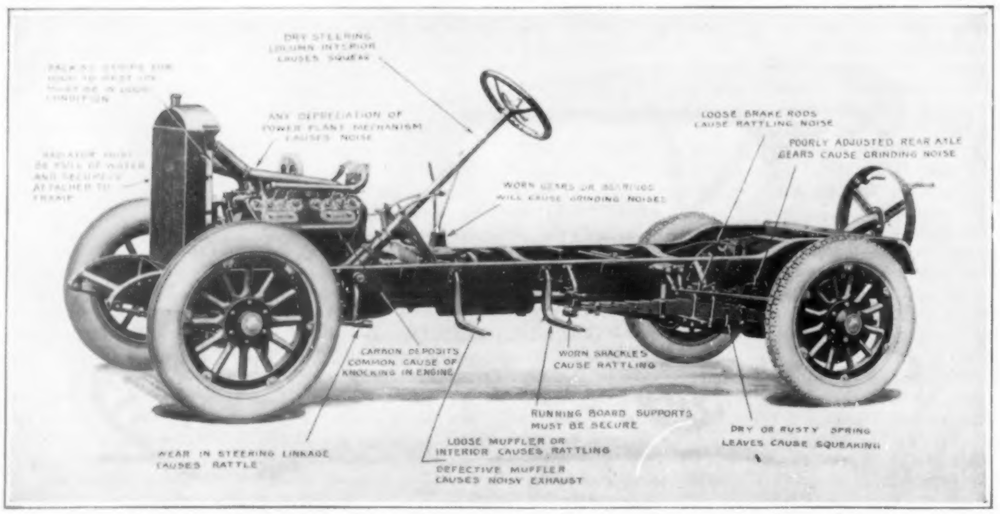
Adelaide, S. A.

Where Is That Rattle?

The Commoner Automobile Noises, Their Causes, and How to Locate Them

By Victor W. Pagé, M.S.A.E.

THERE are many motorists who abhor a strange noise while their automobile is in operation and who cannot drive with any degree of comfort until the source of the offending sound is located and the cause eliminated. By far the larger number of motorists ride on blissfully unconscious of strange noises, and some apparently do not notice rattles, knocks or squeaks that may be plainly heard by the passer-by. Noisy action is not apt to materialize the first year that a car is put into service because almost anyone, until the novelty of possession wears off, will take the trouble to screw down the grease cups and give the chassis parts, not provided with other means of oiling, at least a perfunctory squirt or two with the common or garden variety of spring bottom hand oiler.

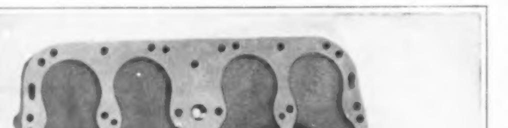


Side view of a typical eight-cylinder chassis showing points on the frame that may cause noise

The car that has been operated for several seasons, regardless of the care that has been taken of it, is apt to develop a number of noises when it is operated over highways that have even minor irregularities of surface. This results in the car running to the accompaniment of a number of rattles and squeaks that prove very annoying to those experienced motorists who desire a smooth-running and silent car. Some noises that seem to pressage serious troubles are due to chassis parts that are not very important and an operator may be caused considerable anxiety by a loud and constantly recurring noise that can be easily prevented by locating it and using a few drops of lubricant at the dry point.

The noises that are most common in the automobile mechanism may be grouped in four main classes. The most important of these are due to depreciation or other causes in the engine; then there are those caused by worn parts producing lost motion in the power transmission mechanism. A series of rattling noises are caused by wear in the running gear components and then there are a number of squeaks that result from looseness in the body and its auxiliary equipment.

In attempting to locate noise the correct procedure is to inspect the car in a systematic manner and look over the various parts of the mechanism that are apt to be noisy in action if they are not properly adjusted and lubricated.



The detachable head, now a feature of most engines, makes it easy to remove carbon from the engine interior and eliminate one fruitful source of noise

The power plant is the most common source of noisy action, but one can easily prove whether that member is at fault or some other part of the car by coasting down a moderately steep hill with the engine shut off and the clutch released. Obviously, if the noise still persists it is safe to assume that it exists in the transmission system or in the chassis mechanism of the car. The most common engine noise is a dull thud or knock which is generally due to excessive carbon deposits or overheating when it is not caused by driving with a spark too far advanced or by worn bearings and other mechanical parts.

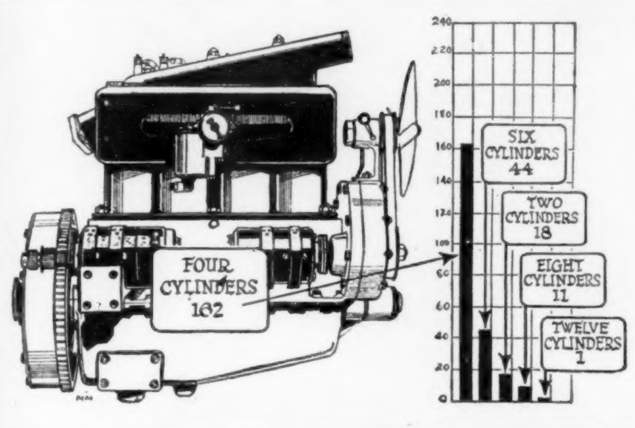
If the knocking is due to carbon deposits the only real remedy is to eliminate the cause. Most engines are now designed with cylinder heads that are readily detachable so the carbon may be easily scraped out of the combustion chamber interior as frequently as may be necessary. It is also possible to have a service station mechanic burn out the carbon by use of a combustion process employing a jet of oxygen. If the knocking noises are due to worn bearings at either end of the connecting rod or on the crankshaft main journals, it can only be remedied by taking up the lost motion existing at those points. In an engine that has been operated for some time cylinders may wear out of round or the pistons may change their form to such an extent that a dull knock known as "a piston slap" may take place. When an engine is worn to this point it usually calls for the services of skilled mechanics to restore it to full efficiency.

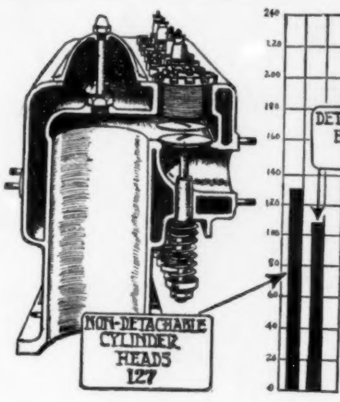
If the noisy action results from over-heating, it may be eliminated by remedying the cause of the excessive temperature rise. The first thing to do is to make sure that there is plenty of the proper grade of lubricating oil in the engine base and that this is of good quality. The next point to inspect is the oil circulation gage to make sure that the lubricant is being circulated through the engine. Among some of the common cooling system troubles that cause knocking may be mentioned insufficient supply of water in the radiator, loose fan belt, buckled hose connections that prevent the water from flowing properly, failure of the water pump drive or of the impeller element of the pump so that the water does not circulate around the water jackets; and in some of the newer cooling systems, functional failure of the thermostat used to regulate the engine temperature. Some of these thermostats are so connected to valves in the cooling system that when the engine is cold, the water is kept circulating only through the engine water jackets and practically none of it reaches the radiator. If the flow control valve becomes stuck in this position it will be apparent that the engine will over-heat even when the radiator is full of water. It is a very simple matter to remedy overheating caused by a loose fan driving belt, as simple, accessible adjustments are usually provided so it is but a few moment's work to adjust the fan belt to the proper degree of tension. A motometer, which is a compact specially devised form of thermometer adapted for installation on the automobile radiator cap is a valuable indicator for overheating troubles.

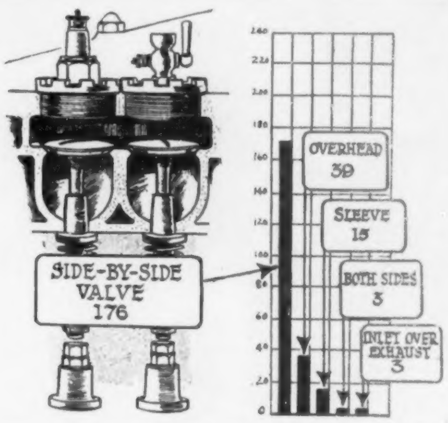
A few of the elusive noises that have nothing to do with the power plant or running gear are indicated in this diagram. If your car rattles or squeaks, inspect the items shown here as possible noise-makers

In most automobiles one is not apt to hear any noise from the transmission system when the car is driven in the high speed unless there is a large amount of depreciation in the bearings of the transmission gear or a poor adjustment of the bevel driving gears at the rear axle. When operating on intermediate or low gear ratios, most cars will produce noise even when the gearset is new, because of the large amount of power transmitted by the gears and the resonance of the hollow metal gear box which intensifies the grinding sound. The only way to reduce this noise to a minimum is to fill the gear case up to the proper level with special gear case lubricant that minimizes the noise by cush-

(*Continued on page 15*)







Graphic charts showing features of automobile engine design favored by European designers and car manufacturers

European Automobile Design for 1921

Where British and Continental Makers Follow and Where They Ignore American Practice

IT is not to be expected, after the experiences that European automobile designers have been through during the readjustment period still existing, that they would incorporate any radical changes on more than detail improvements in automobile design abroad. The year after the war a number of firms, in an attempt to attract attention to their product, evolved models with entirely new features, such as the three-cylinder air-cooled radial-engine power plant. Practically the only thing that may be considered radically new in current automobile engine design as far as Europe is concerned, is a new eight-cylinder English car in which all the cylinders are in line. This is an extremely costly car and will be made only in limited quantities.

One of the most noteworthy features in European design is the development of that class of car which is made necessary by the reduced purchasing power of the public. In Europe, the costs of running an automobile are very much higher than in this country, because of increased cost of fuel, parts, taxes and, in fact, everything for which the car owner has to pay.

There is great development noted in the types that may be called light cars and at the present time this term has been stretched quite beyond its original meaning. In former days a light car was one that did not weigh much in excess of a thousand pounds as a maximum. At the present writing, engineers designing cars weighing over a ton still designate them as light cars. Another thing that is strange to American car buyers is the fact that some of these light cars with small engines, which one would think should be very reasonable in price, cost considerably more than do some of the heavier cars in this country. The main attraction for the buyer of such a product lies in economy of operation because it is now understood that it is not only the item of first cost that determines automobiling satisfaction, but the maintenance or constant cost that obtains all the while the car is in use. As a rule, if a light car is well built it will sell for considerably more money than one expects it should, but this is made necessary because very high grade materials must be employed to secure lightness combined with strength.

It is interesting to note that foreign designers are now beginning to adopt American ideas that were not considered with much favor before the war. Owing to the present high cost of fuel and the scarcity of really skilled service-station labor, many European designers are considering those details of engine construction which make for economy. For this reason there is noted an increasing use of small two- and four-cylinder engines, while the larger engines having six, eight and twelve cylinders are becoming less numerous. Many of the light two-cylinder cars have air-cooled engines of the flat-twin or motorcycle V-engine type and it is claimed that these small power plants, which are rated as delivering from eight to ten horse-power, give real satisfactory service and are adequate for the uses to which they are applied.

The successful use of such small engines is made possible in Europe because the average European driver does not object to shifting gears as American car owners do. The object is not to see how many hills can be raced on the high gear or direct drive, as the European motorist has been taught that changing speed when occasion demands enables him to operate in a practical manner a small power plant that will provide a maximum number of miles traveling for the expenditure, and that will run more economically than the average American engine in similar cars because it is operated nearly all the time at that speed providing greater power output with minimum fuel.

One of the points that was noted at previous European exhibitions was that European designers did not give the same attention to the accessibility of parts as American designers did. When detachable cylinder-heads were first used in the American engines, their adoption created considerable comment on the part of European engine builders who always favored the cylinder type having the heads cast integrally. During the past year a very large number of American cars using the detachable-head feature were put into service and their practical operation and the ease with which the engine interior could be reached for cleaning naturally impressed the foreign designers. A study of their designs shows that detachable cylinder-heads are being used in constantly augmenting numbers.

Another thing that the continental designers were slow to adopt was the use of asbestos friction material for clutch facings, especially on cone clutches, for which purpose leather was being used almost universally. At the present time one notes a growing appreciation of the use of asbestos fabric lining for cone clutches, these fabrics being composed of woven asbestos of a composition somewhat similar to brake linings.

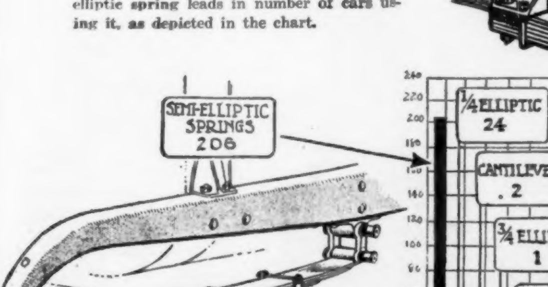
Again, the foreign designers favored the four-speed gear-box for many years, and sometimes very small cars were equipped with change speed gearing of this character. But now, taking a lesson from American practice, we find that the three-speed gear is beginning to increase in number. Spiral-bevel rear-axle drive-gears are also becoming more popular, while the straight-tooth bevel-gears have lost a considerable degree of the popularity they formerly enjoyed. This shows that the European motorist is becoming more particular and desires that quietness of action which is characteristic of most of the cheaper American cars just as much as it is of the higher priced product.

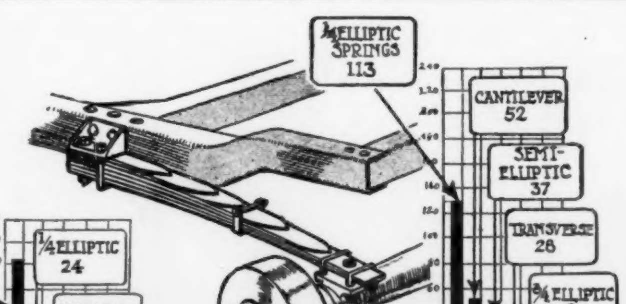
The European motorist who purchases cars consid-

(*Continued on page 19*)

Below

How the front end of most European automobiles is supported. Note that the semi-elliptic spring leads in number of cars using it, as depicted in the chart.



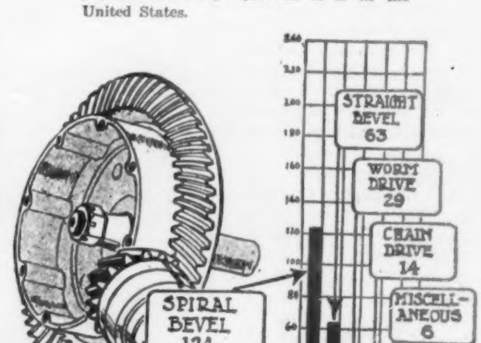


Above

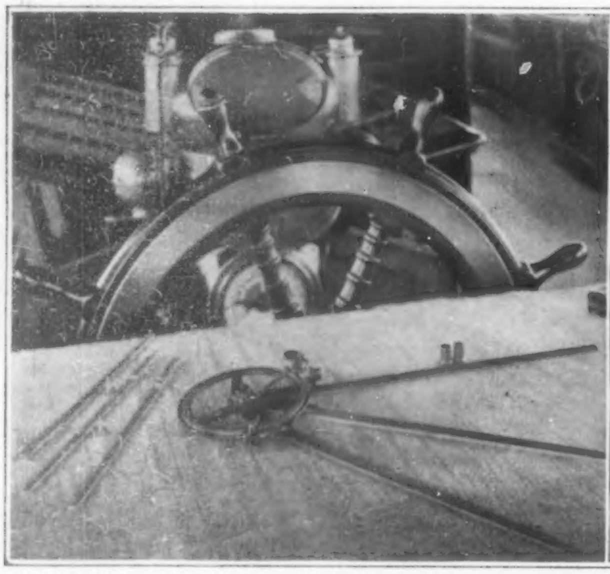
The most popular type of rear suspension, which leads all other types by a margin of more than 100 per cent.

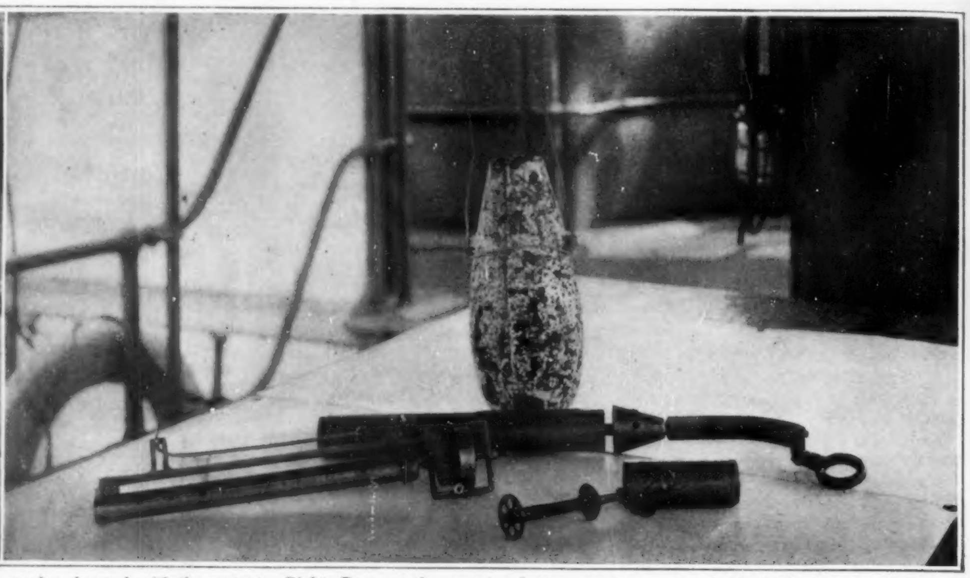
Below

Spiral bevel final drive gearing is the most popular in Europe just as it is in the United States.



Some features of the European passenger car chassis are shown in the graphic charts above, which clearly outline trend of practice in foreign car design





Left: The three-arm protractor for locating the position of the vessel from angles observed with the sextant. *Right:* Deep-sea thermometer, bottom specimen cup and detachable sinker used in real deep-sea hydrography

Some of the apparatus used in mapping the bed of the ocean

Mapping the Waters Along Our Coasts

How the Hydrographic Surveyor Obtains Exact Information About the Sea Bottom

By Louis C. Kane

THE Coast and Geodetic Survey Steamer "Bache," a composite steamer of 472 tons, with a complement of eight wardroom officers and 45 enlisted men, has been working off the Delaware Breakwaters since May of last year, making a complete hydrographic survey of the approaches to Delaware Bay. The Government's project includes a survey from the Delaware shore out to the 100-fathom curve, and from the light of Fenwick Island and the Light and Shoals vessel, to the entrance of New York Harbor. After November, when weather conditions became such that little field work could be done, operations in the Delaware waters ceased until next April. The "Bache" returns to the Breakwater anchorage every week-end, leaving for the working grounds just outside the Capes on Monday mornings.

The "Bache" is fitted up with numerous scientific and navigating instruments. Forward is the chart room where experts record daily soundings on charts; huge buoys, tackle and rope literally cover her deck, and below aft is a spacious room with office equipment where the ship's executive work is done. Aft on the main deck is a winch engine, which handles the sounding line graded to fathoms and feet and so read by the leadsman. An ordinary hand line with 12 pounds of lead is used for soundings up to 15 fathoms, and a 20- or 30-pound lead line for depths between 12 and 15 fathoms. Above 25 fathoms an electric sounding machine is used. The lead is fastened to a traveler near the stern and runs forward by gravity to a point near the bow, where it is automatically released. The leadsman reads the line when the ship has moved forward to the point where the lead was released. This line is hauled in taut, straight up and down, and the depths ascertained. Soundings are made with speed at five miles per hour.

The "Bache" steams out to sea, picks out three stationary objects on shore for signals, and through a two-section angle instrument, figures out its position by trigonometry, each day resuming its work exactly where it left off the day before. There is also on board a three-arm protractor or station pointer which graphically determines the ship's position at any time it is desired to know it.

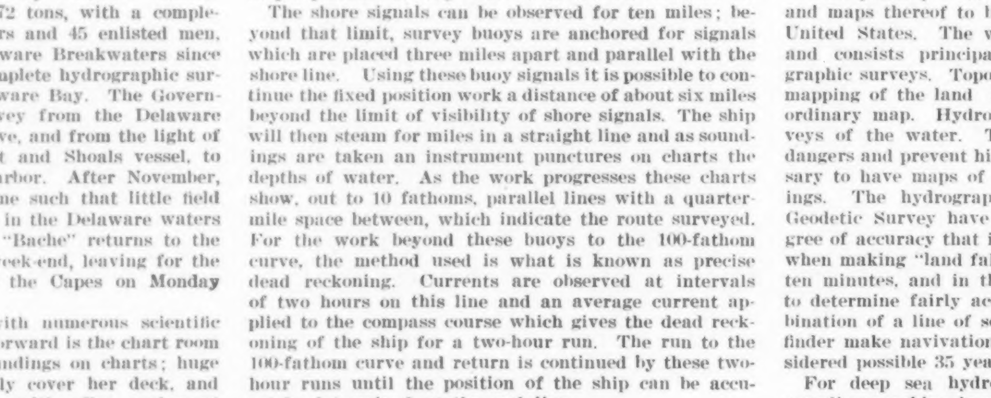
The shore signals can be observed for ten miles; beyond that limit, survey buoys are anchored for signals which are placed three miles apart and parallel with the shore line. Using these buoy signals it is possible to continue the fixed position work a distance of about six miles beyond the limit of visibility of shore signals. The ship will then steam for miles in a straight line and as soundings are taken an instrument punctures on charts the depths of water. As the work progresses these charts show, out to 10 fathoms, parallel lines with a quarter-mile space between, which indicate the route surveyed. For the work beyond these buoys to the 100-fathom curve, the method used is what is known as precise dead reckoning. Currents are observed at intervals of two hours on this line and an average current applied to the compass course which gives the dead reckoning of the ship for a two-hour run. The run to the 100-fathom curve and return is continued by these two-hour runs until the position of the ship can be accurately determined at the end line.

Soundings are reduced to mean sea level and finally placed on the charts of the coast. Unless taken at low water a little more water in a given locality will be found than the charts show.

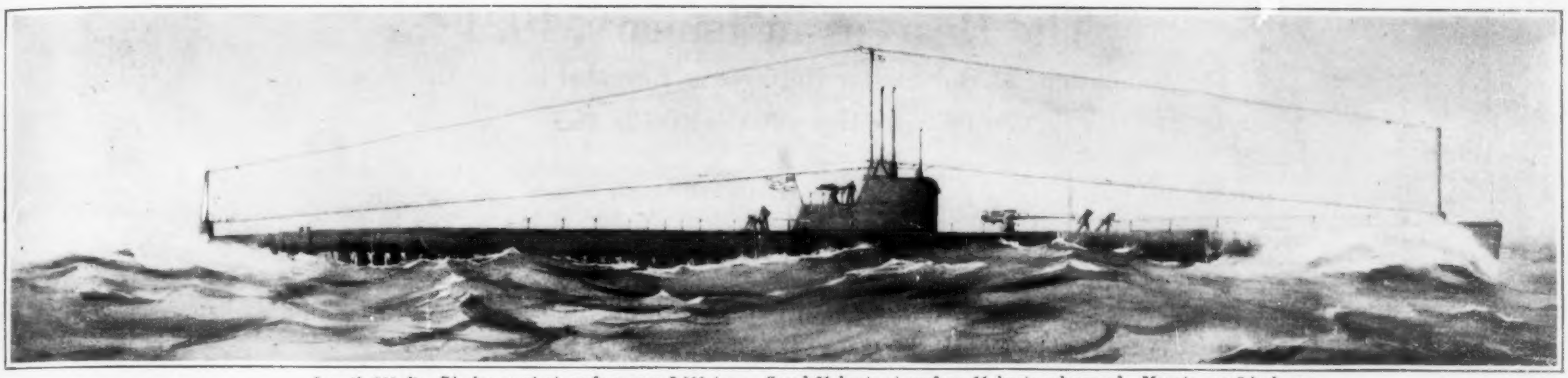
In explaining the work of the Coast and Geodetic Survey, Commander H. A. Seran of the "Bache" said:

"Our primary work is to cause an accurate survey and maps thereof to be made of the shore line of the United States. The work is along shore and inland, and consists principally in topographic and hydrographic surveys. Topographing surveying is merely the mapping of the land the same as you will see in any ordinary map. Hydrographic surveys are simply surveys of the water. To enable the mariner to avoid dangers and prevent his sailing on the beach, it is necessary to have maps of the water and numerous soundings. The hydrographic surveys of the Coast and Geodetic Survey have been carried out to such a degree of accuracy that it is easily possible for a mariner when making "land fall" to sound at intervals of about ten minutes, and in the course of an hour to be able to determine fairly accurately his position. The combination of a line of soundings and the radio direction finder make navivation much safer than was ever considered possible 35 years ago."

For deep sea hydrography the Sigsbee Deep Sea sounding machine is used, and instead of an ordinary hand line, piano wire is used. The weight consists of a cast-iron pear-shaped shot, with which is used a specimen cup for obtaining specimens of the bottom, and a deep sea thermometer for obtaining temperatures at the ocean bottom. When the bottom is reached at, say, 3,000 fathoms, the cast-iron shot of 60 pounds is automatically released and the specimen cup with the thermometer alone brought to the surface. The thermometer is an ingeniously devised instrument, built to withstand the enormous pressures at the bottom and to record the minimum temperatures reached. It consists of a framework, the thermometer itself inclosed by a metal jacket, and the whirling vane. Going down this vane is at the top. When bottom is reached and the upper pull commenced, the vane rotates, causing the thermometer to capsize; and the mercury column is broken. Upon coming to the surface in high water temperature the excess of expended mercury in the bulb is taken care of in a small reservoir. The minimum high temperature at the bottom is read by the length of the column of mercury left in the bore.



United States Coast Survey steamship "Bache"



Length 300 ft. *Displacement* at surface over 2,000 tons. *Speed* 21 knots at surface, 11 knots submerged. Mounts one 5-inch gun

New United States Fleet Submarine

The Fleet Submarines for the United States Navy

THE Naval Appropriation Act of August 29, 1916, authorized the construction of a group of nine Fleet Submarines. Three of these have been constructed and bids for the other six are now under consideration. The accompanying official wash drawing gives an excellent idea of these vessels as they will appear when completed and at sea.

The designs were prepared by the Navy Department and by taking the men shown upon the deck in this picture as a scale, it will be realized that they are very large craft for vessels of the submarine type. The length overall is 300 feet, and their displacement, when traveling on the surface, will exceed 2,000 tons.

The propelling machinery for surface operation consists of two main Diesel engines, each of 2,500 horse-power, located in the after part of the hull, driving directly on the main shafts, and two auxiliary Diesel engines, each of 1,000 horse-power, in the forward portion of the boat, driving electric generators which, in turn, supply electric current to two main electric motors, one on each main shaft. When operating submerged, the vessel will be propelled by the two main electric motors, taking current from a powerful storage battery. It is estimated that the maximum surface speed, under full power, will be 21 knots per hour, and that nearly half that speed will be attainable in submerged condition. The fuel oil capacity is such as to provide for a large radius of action, and the vessel will be entirely capable of accompanying the fleet under all conditions.

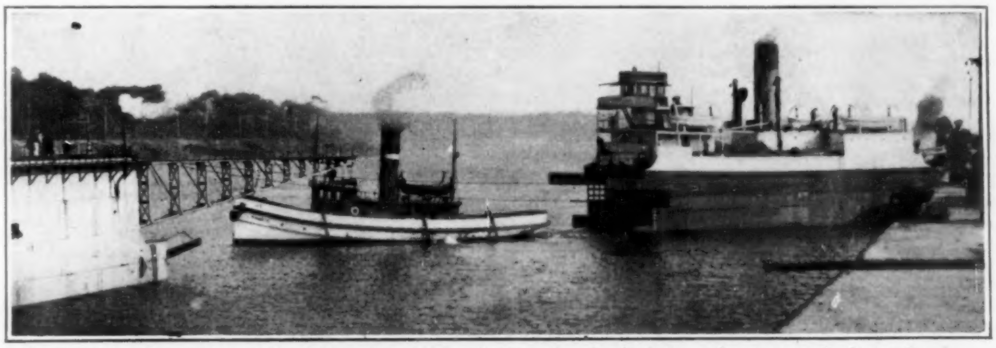
The armament includes torpedo tubes in the bow and stern, with an ample allowance of 21-inch torpedoes. There will be a 5-inch gun mounted on deck, forward of the conning tower.

Three periscopes of the latest improved patterns will form a part of the equipment, and each vessel will be provided with the latest type of radio telegraph outfit, both for surface and submerged work, also with listening devices. Commodious and comfortable quarters have been provided for the officers and crew.

Particular attention has been given in the design of the structure of the vessel to insure adequate strength of the hull to resist the pressure due to deep submergence and to provide against rupture due to the explosion of depth charges.

Taking a Ship Through the Locks in Sections

EVERY so often a steamer whose length is greater than that of the lock chambers must be taken through the locks, in which event it becomes necessary to take the ship apart in order to get through. A case in point was that of the steamer "Canadian Runner," which was divided into two parts and brought all the way through from Port Arthur, Ontario, to Montreal. The Lachine Canal locks are not large enough to accommodate a steamer of the length of the "Canadian Runner," hence it was necessary to cut the rivets and divide the ship in two parts, the rear section being shown in the accompanying illustration. Once safely through the locks and at Montreal, the fore and aft sections were brought together in a drydock and riveted so as to complete the "Canadian Runner." To the layman this business of cutting a ship apart, bulkheading her so she will float, hauling the two parts separately for thousands of miles, and then patching them together again as good as ever, smacks of wizardry; but to the engineer it is all part of the day's work.



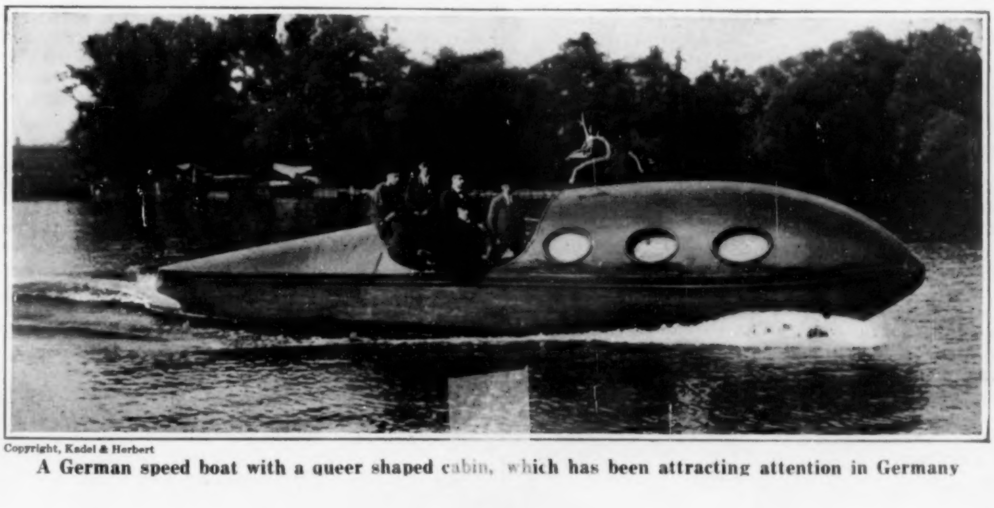
Towing the aft section of the "Canadian Runner" into the drydock in order to couple it to the forward part and complete the steamer

The Singing Flame Employed as an Indicator for Explosive Mixtures of Gases

A GERMAN scientist, Professor Fleissner, has recently patented a new form of indicator for use in mines and other places, where explosive mixtures of gases are liable to occur. In the well-known safety lamp invented for miners by Sir Humphrey Davey, an excess of methane in the air is made known by the visible aureole which surrounds the flame, but in Professor Fleissner's device it is the more reliable sense of hearing which gives the warning. His invention is based upon the well-known phenomenon of the so-called singing flame, sometimes known as the chemical harmonica.

Even school children nowadays are familiar with the fact that when a stream of gas is passed through a long, narrow tube and set fire to at its exit, the flame utters a definite musical note varying in strength and pitch according to the dimensions of the tube. Professor Fleissner repeated this experiment, not only with ordinary illuminating gas, but with hydrogen and with acetylene; the latter gave a particularly powerful note and at the same time the flame flickered and jerked in a lively manner, whereas the singing flame produced by illuminating gas appears to burn quite quietly. By making the flame larger or smaller the tone produced can be made louder or fainter at will, and in accordance with this law the sound ceases entirely when the flame attains a certain size, but when an inflammable gas is allowed to enter the lower end of the tube whose upper end bears a silent flame, the latter is increased in size, and as a result of this the flame once more begins to sing; but as soon as this extra gas ceases to be supplied the sound naturally ceases.

Taking a hint from this circumstance, Dr. Fleissner arranged an apparatus with a flame just large enough to be silent when burning in ordinary air; but as soon as this device is carried into a chamber containing explosive gases, the flame at once becomes larger and promptly starts singing. In place of the glass tube used in the ordinary experiment the inventor makes use of a hollow metal ball having two cylindrical necks, thus rendering it possible to give his apparatus the form of a mine lamp. His device consists of a flame which can be regulated and which is surrounded by a glass cylinder which is inserted in the lower neck of the hollow ball, while the upper neck acts as a flue, both being surrounded with a wire basket. The whole apparatus is mounted on a pole with a handle. When it is to be used the burner is first arranged so that a tone is produced and then is shifted so that the tone ceases; as soon as any new explosive gases reach the lower end of the glass cylinder the sound at once recommences. The note produced may be interrupted when the lamp is removed from the point where it began to sing and in this manner a *quantitative measurement* of the amount of explosive gases present may be made, since, of course, the nature of the sound depends upon the quantity of explosive gases present.—By *M. Tevis.*



A German speed boat with a queer shaped cabin, which has been attracting attention in Germany

Something Different in Speed Boats

FROM Germany comes the accompanying photograph of a new speed boat which is claimed to be the last word in such craft. The boat is built like a whale, we are informed, and when running at high speeds it glides over the water with ease. The power plant is reported to be a 200-horse-power engine. Aside from the odd cabin of this speed boat, there does not appear to be any radically new principle involved.

The Heavens in January, 1921

The Dimensions of Our Stellar Universe as Revealed in the Milky Way

By Professor Henry Norris Russell, Ph.D.

TWO months ago we spoke of the researches of Professor Kapteyn and his assistants upon the relative numbers of stars of different degrees of real brightness. We may now return to another side of these investigations—which would have been presented last month, had it not been for the loss of a manuscript in the mails, and the substitution of one written on a different topic.

If we know the distribution of the stars among the relative degrees of brightness, both as they *appear* to us in the sky and as they really *are*, we may use this knowledge to solve a still more interesting problem—that of the manner in which the stars are distributed in space.

To see how this may be done, let us suppose that space is sown everywhere equally thick with stars, and is transparent, with nothing in it to absorb or weaken light, even during a journey of many thousands of years; and let us consider first the stars of some fixed degree of real brightness—say those equal to the sun. Such a star would appear to our eyes as a star of the second magnitude if its distance were nine light-years; of the third magnitude at 14 light-years; of the fourth at 23 light-years; of the fifth at 36 light-years; and so on, each instance being 59 per cent greater than the last. If a star (of the sort considered) appears to us to be between the second and third magnitudes, its distance must be between nine and fourteen light-years—that is, it must be within a certain hollow shell of space, bounded by concentric spheres of these radii. A star which seems to our eyes to be between the third and fourth magnitudes must be within a larger hollow shell enclosing the first, of inner radius 14 and outer radius 23 light-years—and so on. Now a very simple calculation shows that the volume of space contained within each of these successive hollow shells is almost exactly four times as great as that contained within the preceding shell, which lies just inside it. Hence, if the stars are scattered uniformly in space, we should get four times as many of them in the larger shell. That is, there should be four times as many stars which appear to us to be between the third and fourth magnitudes, as there are stars between the second and third magnitudes—and so on indefinitely, *the number of stars increasing four-fold, in geometric progression, for every step of one magnitude fainter*.

For stars of some different real brightness—say 100 times as bright as the sun—the limiting distances would differ, being ten times as great in this particular case suggested. But the *proportional* distances for different magnitudes would be unaltered and the final proposition, italicized above, would still hold true. Hence it must be true for a mixture of stars of all degrees of brightness, so long as this mixture of stars is scattered uniformly throughout the whole of space.

Hypothesis and Fact

If, however, the remoter regions of space are more thinly peopled with stars than those which lie near us, the proposition will no longer be true. The larger shells, within which must lie the stars which look faint to our eyes, will contain fewer stars in proportion to their volume, and the ratio of the number of stars of one magnitude to that of the number of stars of the next brighter magnitude will no longer be exactly four, but will fall off more and more as we come to the fainter and more distant stars.

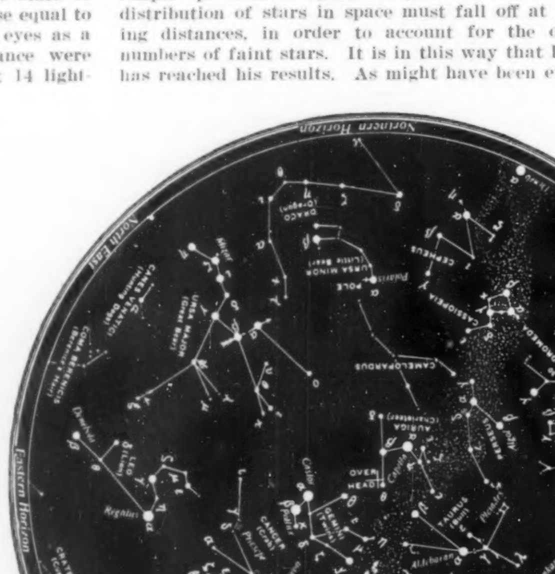
Now this last situation is what we actually find in the heavens. Among the very brightest stars, which are conspicuous to the eye, the ratio of increase from one magnitude to the next is indeed nearly equal to four. But when we get down to the tenth magnitude it drops to about three; and for the 17th magnitude, the faintest so far studied, it has fallen to only a little above two.

This shows conclusively that the more distant regions of space, within which the majority of these faint stars lie, must be much more thinly filled with stars than the regions near the sun. Other interesting conclusions follow: for example, we know that among the twenty stars which appear brightest to us, the majority are objects of very great luminosity, exceeding the sun by more than a hundredfold. But it would not be safe to conclude that half of the stars of the fifteenth magnitude were really a hundred times as bright as the sun; for the exceedingly remote parts of space in which stars would have to be in order to appear to us so faint, are almost empty; and we get far fewer such objects, in proportion, among the stars of the fifteenth magnitude, than among those of the first.

Measuring Our Universe

Knowing the relative numbers of different degrees of luminosity, it becomes a soluble—though hardly a simple—problem to figure out just how the density of distribution of stars in space must fall off at increasing distances, in order to account for the observed numbers of faint stars. It is in this way that Kapteyn has reached his results. As might have been expected, he has discussed different parts of the sky separately—there are many more faint stars in proportion to bright ones in the Milky Way than in other regions of the sky; and this indicates that the distance to which we would have to travel in order to reach a region in which the stars are thinly scattered must be much greater in the direction of the Galaxy than in that toward the galactic pole.

In the latter direction, Kapteyn finds that at a distance of 600 light-years from the central plane of the Galaxy, there are only half as many stars in the same volume of space as there are in the central plane itself. At 1800 light-years the star-density is reduced to one-tenth of the maximum; at 4000 light-years to one one-hundredth; at 7500 light-years to one one-thousandth. In the plane of the Milky Way, taking a sort of general average for different directions, we would have to go some 2300 light-years to get the density down to one-half the maximum; 8000 light-years to reduce it to a tenth; 28,000 to bring it down to one one-hundredth, and about 75,000 light-years to find a region where the density would be one one-thousandth, and the stars ten times as far apart, on the average, as they are near the sun.



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9½ o'clock: Jan. 29.

NIGHT SKY: JANUARY AND FEBRUARY

These calculations exhibit the Milky Way as a huge flattened cluster of stars, thickest at the center and thinning out gradually. The denser parts are included within a region some 3,500 light-years in thickness, and perhaps 16,000 in diameter; but stragglers are found within a region five times as thick and ten times as broad.

The conclusions regarding the thickness of this flattened cluster are based on a definite discussion of the available material, and represent the best knowledge at present to be attained. The values given for the diameter are, however, preliminary, and will in time be replaced by those resulting from a more exhaustive study, which will take some time longer to complete, and will take account of the possibility—indeed probability—that the Milky Way extends to different distances in different directions. In their present state, however, these inquiries mark a notable advance in our knowledge of the universe of stars, and certainly cannot fail to give us a lively sense of the tremendous magnitude of that universe.

The Heavens

The winter constellations are now full in the south. Orion is high on the meridian, with Canis Major below on the left, Taurus above on the right, Gemini above on the left, Canis Minor below this, and Auriga, highest of all, right overhead. Far down on the southern horizon observers south of Virginia may see the brilliant Canopus—next to Sirius in brightness among the stars.

Leo is well up in the east, and Hydra has half risen in the southeast. Ursa Major is conspicuous in the northeast, while Draco and Ursa Minor are low in the north, and Cepheus and Cassiopeia sinking in the northwest. Perseus, Andromeda and Aries are in the west, and Eridanus and Cetus in the southwest.

The Planets

Mercury is in conjunction with the sun on the 16th and is practically invisible. Venus is very conspicuous as an evening star, and sets about 8.30 P. M. in the middle of the month.

Mars is an evening star, close to Venus. On the evening of the 8th he is in conjunction with the latter and only half a degree away. Uranus at the same time is but a quarter of a degree north of Mars. So close a conjunction of three planets at once is unusual enough to be interesting, even though one of them is invisible to the naked eye.

Jupiter is in the eastern part of Leo, and rises at about 9.30 P. M. in the middle of the month. Saturn is five or six degrees farther east, and just over the border of Virgo. He is a very interesting telescopic object just now, for his rings are turned almost edgewise toward the earth and sun. During this month indeed we see the dark side of the rings, illuminated very faintly by sunlight which filters through between the free particles of which they are all composed, and as well by light reflected from the planet.

Uranus is an evening star, close to Venus and Mars; while Neptune is in Cancer, observable only with telescopic aid.

The moon is new at 12.27 A. M. on the 9th, in her first quarter at 1.31 A. M. on the 17th, full at 6.08 P. M. on the 23rd, and in her last quarter at 3.02 P. M. on the 30th. She is nearest the earth on the 23rd, and farthest away on the 9th. During the month she passes near Mercury on the 8th, Uranus on the 12th, Venus and Mars on the 13th, Neptune on the 24th, Jupiter on the 26th, and Saturn on the 27th.

Skjellerup's Comet

Telegraphic announcement has just been received of the discovery of a faint telescopic comet by Skjellerup—at what observatory is not stated—on December 13th. The comet was then in R. A. 8h. 55m. 12s.,

(*Continued on page 20*)

A loud-speaking 'phone that strikes out over new ground

New Style of Amplifying Telephone of Simple Construction

A NEW type of loud-speaking telephone, claimed to have better speaking qualities and of simpler construction than other types, has recently been placed on the market by a New York electrical engineer. The illustration above shows the several parts of the new instrument.

The advantages of the instrument are obtained through what the inventor terms a "mechanical amplifier." A very intense magnetic field is used in the receiver and instead of using the speaking diaphragm as an armature, a small cube of soft iron is used and this is attached to a lever, one end of which attaches to the center of the diaphragm. The lever magnifies the motion of the armature, so that a very small movement produces the large amplitude of vibration necessary for a loud-speaking telephone.

The intense magnetic field is obtained through the use of two horse-shoe magnets, each of which is magnetized so that it will pick up three and a half pounds of iron.

These magnets are clamped together in a non-magnetic frame and between the ends of the poles is clamped a laminated soft-iron core, which forms the core for the speaking coil.

The sensitive transmitter is of the typical carbon-button construction, but the diaphragm is very large. The back carbon of the button is adjustable so that any desired density can be obtained in the carbon granules and the sensitivity of the instrument can be varied at will.

This set is used at one end of an ordinary telephone circuit and no amplifiers are needed. The loud-speaker can be adjusted so that it can be heard at a distance of 200 feet in the open and the transmitter is sensitive to ordinary speech up to distances of from 40 to 50 feet.

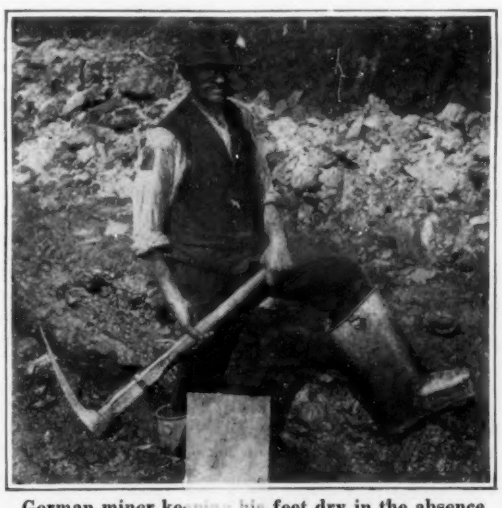
It is claimed that once the instruments are installed and adjusted to meet local conditions they need no more attention than an ordinary telephone instrument and can be depended on for service year in and year out.

The inventor has also devised a switching box to be placed on the desk of the factory executive or other user of the telephone and by pressing a button he is at once placed in touch with any one of his department heads, who need not leave their work to answer him. The use of the loud-speaker for actual conversation rather than mere calling is a decided novelty.

The fact that the diaphragm itself is not used as an armature on the loud-speaker makes it possible to use a mica diaphragm. This, it is claimed, does away with much of the "metallic" sound so common in other types of loud-speaking phones.

Sheet-Iron Boots Used by Coal Miners of Germany

IF there's one man in the world who needs waterproof boots more than the next one, it is the man who has to dig in land that is partly water. Our illustration shows such a worker—a coal miner in one of the German fields, whom the more or less poetic soul of the caption-writer has credited with a share in the payment of Germany's war indemnity. We doubt this—we have a feeling that the gentleman of the picture is interested solely in the origin of his next meal and his night's lodging. Whatever his immediate motive for labor, however, he has simply got to have footwear that will keep the water out; and if there is no rubber to be had he must improvise something in its place. This he has done with the aid of sheet-metal and solder; and we have little doubt that his extraordinary boots will outlast those of more conventional manufacture.

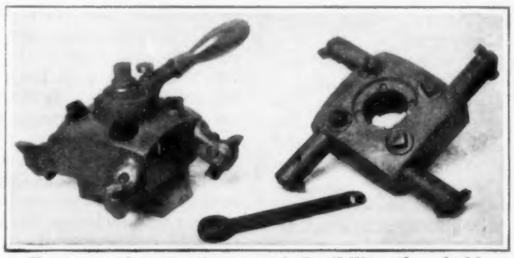


German miner keeping his feet dry in the absence of rubber

A New Turret Tool Post

A VERMONT manufacturer has recently developed a turret tool post which has the advantages of rigidity, ease of operation as well as adaptability through its compactness for use on lathes. The center height of this new device above tool rest may be as low as 1⅜ inches.

The turning and facing cutters are adjustable for height as they become worn by use and grinding. Thus the cutting edge may be kept on center without sacrificing the strength and rigidity as is done in ordinary tool posts. By one movement of the binding lever the operator releases, accurately indexes to the next tool position and again rigidly clamps the turret to its base. The turret rings are interchangeable on any base.



Turret tool post of unusual flexibility that holds the tool rigid

An Extra Passenger in the Side-Car

THIS folding side-car seat makes it possible to take an extra passenger along with you in an ordinary side-car. The weight of the child is taken off the car rider's lap, thus making the trip more enjoyable for both. When the seat is folded beneath the cowl it serves to hold parcels; automatically bringing the lower cross-bar into position for use as a sturdy foot-rest. It slides to either side leaving a ten-inch space in the car for a suit-case alongside, still affording room beneath the seat for the rear riders' feet. When folded it is completely off the floor space and out of the way. It is light, durable, detachable, adaptable to any side-car and low-priced, and accommodates an adult or a child in substantial comfort, although it is of course primarily designed for occupancy by a child.

A side-car seat for the baby that folds away when not in use

"Evaporometer" of the U. S. Forest Service

Measuring Evaporation

IF you live on a mountainside and desire to study climatic conditions—the effects of evaporation on crops and trees—an instrument designed by C. G. Bates of the United States Forest Service should render helpful guidance. Invented to measure the rate of evaporation in the National Forests, which may vary widely from day to day as influenced by wind, sunshine and temperature, the apparatus is of consequence in the summer months when the warm wind blows down the side of the mountain. Frequently severe injury to trees results from the intensity of the vapors originating in evaporation and carried by these warm winds.

Described as an "evaporometer," the device is only 7 inches high, weighs one pound, and is of an indestructible nature—usable in winter as well as summer. However, the rate of evaporation in the National forests during the winter months is insignificant. When the winds of summer beat against the hilly slopes, evaporation is an important factor, causing severe injury to trees. This damage is apparent in the spring of the year when the foliage takes on a brownish hue.

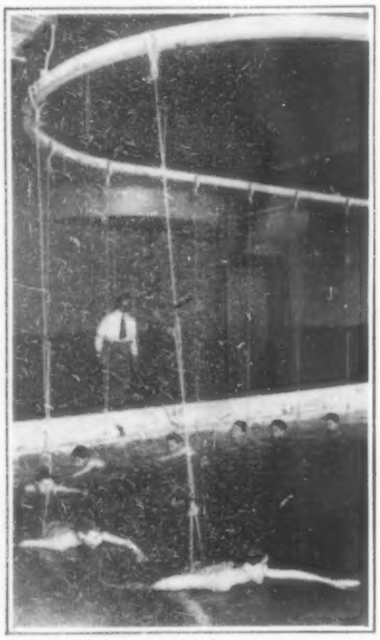
The instrument is simple in its principle of operation. A wick is fed by water from a small, seamless tank, which is so arranged in position as to be always exposed to the effects of wind and sun. The apparatus, according to claims, is less cumbersome and more precise in its determinations than the tanks of water formerly used by the United States Weather Bureau at the forest observation stations. The photograph shows the "evaporometer" in use in Saline County, Nebraska, the instrument being under a makeshift shelter. The apparatus is used only at night and during rains.—By *S. R. Winters.*

Protecting Iron with Cadmium

SINCE cadmium belongs to the same group of metals as zinc, it is natural that inventors should have made the effort to substitute it for the latter metal in the process of galvanizing iron. Recent endeavors along this line have met with success, according to M. Grès of the French Bureau of Inventions, who states in the official *Bulletin des Inventions* that cadmium is less alterable either by moist air, by acids, or by salt water than zinc. Although cadmium itself is comparatively high priced, it can be applied with good results in such a very thin layer, about 35 grams per square meter, that the process is not at all costly. The coating of cadmium adheres very closely to the other metal and the cadmium is sufficiently plastic for the pieces of iron thus protected to be either stamped or bent without destroying the protective layer. If anything, the showing here is better than that of zinc.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



One swimming teacher to a dozen novices in the art

An Overhead Trolley for the Swimming Pool

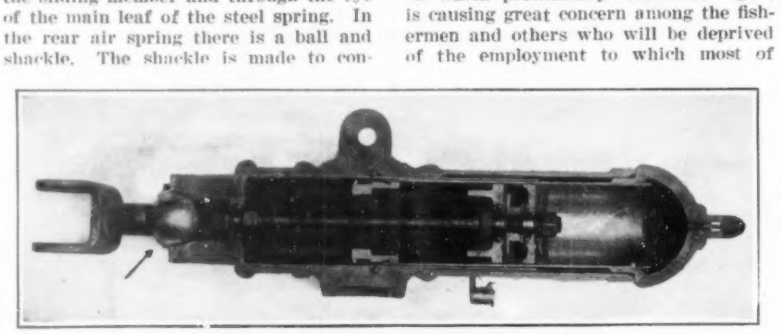
THOSE of us whose shrinking dispositions prevented us from learning the gentle art of swimming from the other "fellers" under natural surroundings, and who were later called upon to acquire it in the swimming tank of high-school, club or college, will recall the cross between a trolley pole and a fishing rod at the end of which we made our first venture. But this apparatus is rather tough on the instructor who has to hold down the land end of it, and it is open to the objection that only one student can have the attention of the said instructor at a time. A Cincinnati school has met this situation in a highly ingenious way by the installation of a circular track above its tank, on which the trolleys supporting the aquatic novices run. The single instructor can range freely about the edge of the pool, paying attention to a large group of beginners at once and accomplishing the same result in a fraction of the time formerly required. At the same time, the old puzzle of whether the learner was really propelling himself through the water or being dragged by the instructor is disposed of for keeps.

A Shock Absorber That Is Different

THE first feature to be observed in the construction of this absorber—called an air spring by its makers—is the simplicity. The spring consists of one working part, and is absolutely air controlled instead of oil controlled as other types of air springs.

The only purpose for which the oil has to serve in this spring is to form a seal to hold the air. There is no dependence upon the passage nor transmission of oil or air from one chamber to the other in order to get action of the spring. There are instead two separate and distinct chambers, one above and one below the piston head, so that both the downfall and recoil of a shock are absorbed on air cushions.

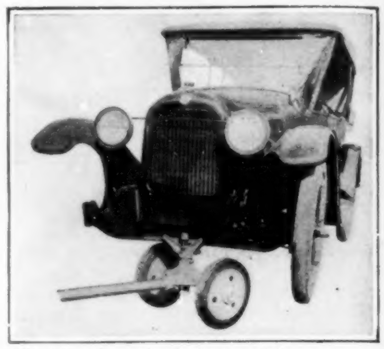
When installing these springs on a car it is not necessary to shape nor form-cut the steel springs. The sliding member of the front air spring is milled to conform to the full width of the steel spring, and made fast by a pin through the sliding member and through the eye of the main leaf of the steel spring. In the rear air spring there is a ball and shackle. The shackle is made to conform to the full width of the steel spring and drilled to conform to the size of the eye in the main leaf of the steel spring, and the original pin that now attaches the frame to the steel spring is used in making the shackle attachment. The ball rests in a socket in the sliding member of the air spring which absorbs all play required by action of the steel spring or difference in the elevation of the two sides of the car, thereby relieving the frame and steel spring from all severe strain.—*By C. W. Geiger.*



A shock absorber that works with air alone

The Smooth and Silent Wrecking Truck

THE clatter of the iron-bound wrecking truck is no more for an Indiana manufacturer has placed a new rubber-tired machine on the market. The 3-inch solid rubber tires fit wheels which are 16 inches in diameter. The wheels are equipped with roller bearings. The axle does not revolve but is permanently fastened to the frame of the truck. This arrangement gives additional strength and rigidity to the machine. The long bearing in the frame supports the saddle post and this overcomes a tendency to keel and prevents smashing the truck when going over roads which are extremely rough. The saddle post is adjustable and the saddle will fit any part of the front or rear axle. A clamp secures the device to the front axle and the spider shape of the saddle with its supporting arms makes a perfect support for the differential of a rear axle.—By *Allen P. Child.*



Moving the crippled car without rousing the whole neighborhood

Some Economic Results of Draining the Zuider Zee

THE draining of the Zuider Zee upon which preliminary work has begun, is causing great concern among the fishermen and others who will be deprived of the employment to which most of them have devoted their entire lives, and who must engage in occupations to which they are complete strangers, unless they can live upon the compensation that is expected to be granted by the National Government of Holland for the loss they will suffer.

Besides fishermen and others deprived of employment many thousands of people will be directly or indirectly affected in their earnings or their property. This class includes practically the entire population living near the Zuider Zee, and numbering, it is estimated, about half a million people. Besides the fishermen who will suffer, thousands of persons engaged in selling, curing, transporting, and otherwise dealing with fish will be affected, while buildings and other property used in the fish trade will much depreciate in value.

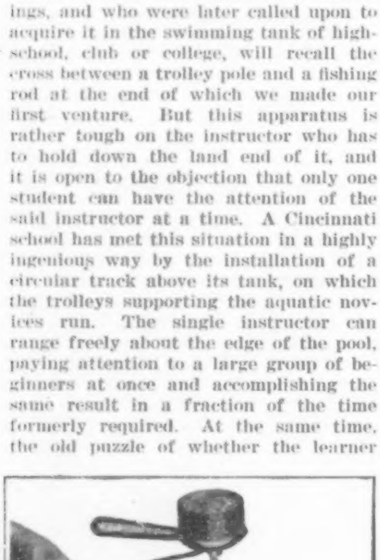
Attempts have been made to estimate the direct annual damage which will result to the affected classes, and it is placed at 3,000,000 florins ($1,206,000) at the least. The probable indirect loss has not so far been estimated.

A commission representing the National Government is visiting the affected districts and studying the conditions there with a view to rendering a report upon which compensation for the loss may be based. It is not supposed that indirect losses will be covered, but that, as a rule, people, like the fishermen, whose means of livelihood will be entirely destroyed, will receive annual sums sufficient to keep them from want, the amounts to be graded according to the earning ability of the injured party—that is to say, the older he is the greater the compensation. No definite sums have yet been proposed, but suggestions of amounts equivalent to $5 or $6 a week have met with dissatisfied protests.

The work of draining and filling the Zuider Zee cannot be entirely completed for 15 or 20 years, but loss will begin much sooner, with the first interruption to the pursuits of a fishing village.

A Volt-Meter for Tight Places

IT is not always easy to make the physical application of a volt-meter to a battery—especially a battery that is in a more or less awkward place on an automobile. Either we have an entirely rigid instrument in which the dial of the meter is itself an obstruction and prevents our getting down between the binding bars of the battery as we would like, or else we have an apparatus that presents a vast amount of wire to tangle us up. An interesting effort to compromise between these two extremes is illustrated herewith. The contacts are joined to the dial member of the meter by wire, all right enough; but it is a single wire for both contacts, and there is an altogether convenient little handle by means of which the latter are manipulated. It is difficult to imagine a battery so inaccessibly located that it could not be reached and its voltage tested by this instrument.



Handy volt-meter of novel design

Grippers for the Battery

BATTERY men very frequently find it hard to remove the element of a battery by ordinary means. These grippers that have been designed especially for this purpose will do the work in a jiffy. A platform of sufficient size is provided upon which the operator stands with the battery secured to a pipe standard, by means of two small adjusting clips. When the grippers are applied the element soon comes out. The old method was to hold a battery between the feet and use most any tool handy. It is a time and labor saver.—By *K. H. Hamilton.*

A sure-fire outfit for removing the battery element

The Trend of Design for 1921

(*Continued from page 5*)

provided at the middle of the chassis, and contains a leather cup-packed piston, the space behind which is filled with oil. The piston is actuated by a short rod that extends to the brake pedal. Oil-distributing lines of flexible metallic tubing extend to the individual brake-cylinders on the rear wheels and also to corresponding members on the front wheels. It will be apparent that if pressure is applied to the brake pedal oil will be forced through the pipe lines to the four individual braking cylinders and the brake-band sectors will be spread apart with great force. It is stated that the hydraulic system eliminates practically all brake rods except that connecting the master plunger with the brake pedal.

The pressed steel frame has not changed in design for several years, with the exception that in most cars it has been made deeper at the center section, which has made it possible to dispense with running-board supporting-irons. On the sporting types of automobiles that are now so popular, the running boards are replaced with short steps no wider than the entrance doors. While the semi-elliptic spring still remains the most popular form for front suspension, a number of makers are adopting the simple quarter elliptic or cantilever spring for front suspension and the full cantilever spring for rear suspension. Disk wheels are being used in increasing numbers and they are apparently used on all varieties of cars in preference to wood or wire spoke forms wherever a real stylish design is desired. The metal disk wheels are strong and give the appearance of even greater strength and are much easier to keep clean than the spoke forms. They hide much of the car mechanism that is ordinarily exposed with the spoke form of wheel and give the impression of greater simplicity of chassis assembly.

Many refinements of detail are noticed in designs of bodies and especially in the interior finish and appointments of closed bodies. The sedan type is deservedly popular because it is an all-the-year form of car which provides maximum comfort for the passengers in either summer or winter and is best adapted for the rapidly changing weather conditions of the intermediate seasons. In designing bodies of all types the builders have endeavored to secure seating arrangements that will provide maximum comfort for the passengers. There has been no change in such standardized details as steering gears, change-speed, clutch and brake-control systems or the front-axle and steering knuckle construction because these have evidently been developed to a point of practical perfection beyond which it is difficult to go. A general tendency toward making lighter cars is noted and all the various refinements that make for more economical operation are incorporated in those cars designed by engineers who keep in touch with the public demand and who endeavor to cater to its needs.

Automotive Milestones

(*Continued from page 6*)

favor, because it reduces weight most appreciably.

Aside from the use of special steels and aluminum, many engineers have found it possible to reduce weight by the simplification of certain parts and the elimination of non-essential parts. In some instances road shocks are being taken up by flexibility rather than by rigid construction, and this practice serves to keep the weight down consistent with road safety.

The Matter of Tires

Despite numerous attempts to replace the pneumatic tire, with its attendant troubles and high cost and limited life, it still holds the field. Its supremacy is absolute. Practically all automotive engineers are agreed that there is no reason to believe that a substitute for pneumatic tires is in sight. And they are also agreed that all substitutes so far brought to their attention during a period of fifteen years, are questionable. Automobile engineers have nothing but praise for the tire builders, who have steadily kept on improving their product so that many of the former shortcomings of the pneumatic tire have been overcome, particularly in the cord tire. Some engineers believe that much can be done in the way of better spring suspension for taking some of the work off the present-day tires; but the majority seem to feel that the pneumatic tire is the logical means of taking up road shocks. The tire problem is solved to their satisfaction: if the motorist only uses the proper sizes for his car and sees to it that they are kept inflated at the proper pressure, he should have little or no trouble.

Vibration has always been an inevitable feature of the gasoline automobile, especially at low speed. Still, just as noise has been steadily reduced until the present-day cars of the better kind purr along with no more fuss than the electrics, so are the engineers planning to reduce vibration. In the heavier engines vibration has already been reduced to a minimum, largely through the multiplying of cylinders but also through the use of lighter reciprocating parts and careful balancing.

Assuming that the motor is designed correctly with all parts well balanced and such parts as crank-shaft especially being sufficiently stiff, there still remains what is commonly known as torsional vibrations, which occur at various speeds of the motor. The question of eliminating this vibration is successfully met, however, by some makers through the employment of a device attached to the crank-shaft. Some engineers are convinced that vibration can be diminished to almost imperceptible proportions, but others are not so sure of this. One engineer in particular directs our attention to the fact that there is little chance of eliminating any great amount of this vibration, except by the use of six-throw or multiples of six crank-shafts, since theoretically the four-throw crank-shafts used in four- and eight-cylinder engines cannot be balanced. Much is being done through the use of aluminum and composition pistons and connecting rods and other reciprocating parts. Vibration, for most engineers, continues to be more or less of a problem which must be more or less solved, according to the present status of their engines.

In conclusion, it is believed that the advances in automobile design in the next few years will be along the lines of still greater lightness and greater economy in operation. These will probably be made at some sacrifice of power and speed acceleration. In Europe, however, there are now many cars on the market giving economies of around 40 miles to the gallon of gasoline and develop 12 to 15 horse-power. It is probable that as fast as the demand for these light and cheap running cars appears in the United States, the American automotive industry will be able to meet it with engines having fewer disadvantages than the European types.

Where Is That Rattle?

(*Continued from page 8*)

ioning the gear teeth and at the same time that prevents the gear case from vibrating fast enough to produce a musical, or rather one should say unmusical, sound.

A point in the transmission system that produces a rattling noise every time the clutch is engaged or the speed of the car varied suddenly by the accelerator is the universal joint. The reason that this produces noise is that the lost motion between the parts is taken up on the first application of power and the joint is rea-

(*Continued on page 17*)

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

HOSE GUARD.—S. A. WOODRUFF, 500 Central Bldg., Seattle, Wash. Among the objects of the invention is to provide a guard which can be quickly applied to the leg or ankle and

DIAGRAM SHOWING THE POSITION OF THE DEVICE

inserted within the shoe at the heel portion so as to protect the hose from a brush or cloth which is used in polishing the shoes. A further object is to provide a device which can be manufactured at a reasonably low price.

Pertaining to Aviation

SAFETY DEVICE FOR AIRCRAFT.—G. AJELLO, 1 W. 34th St., New York, N. Y. Among the objects of the invention are to prevent the fatal fall of an airplane due to any cause whatever, and particularly nose dives while landing by a device acting automatically through a control of an emergency webbed surface or auxiliary wing to cause the airplane to raise its nose and lower its tail to the ground and stop within a short distance, giving the airplane the properties possessed by birds.

PROPELLER.—F. FOLEY, Gillette, Ark. This invention has for its object to provide a device of the character specified especially adapted for use in flying machines, wherein the propeller has a blade of spiral form so arranged that the pitch of the blade may be varied. The propeller is composed of similar sections, each section being approximately a half circle.

Electrical Devices

OSCILLATOR FOR ELECTRIC FANS.—M. M. GLASSER, 446 King St., Charleston, S. C. This invention has for its object to provide mechanism of the character specified for use especially in connection with ceiling fans, having mechanism for oscillating the motor casing causing the blast from the fan to swing through a fixed arc for continuously changing the direction of this arc, thus greatly broadening the scope of the fan.

PROCESS FOR TREATING MINERAL OILS.—W. JOHNSON, 529½ S. Ervor St., Dallas, Texas. This invention relates to an apparatus and process for cracking crude or mineral oil. Another object of the invention is to provide a device including a pair of spaced electrodes for superheating the vapor on its passage from the vaporizing tank to the condenser to effect "cracking" to a high degree.

FUSE.—P. A. RICCIO, 4547 Park Ave., New York, N. Y. The aim of this invention is to provide a device which may primarily be handled by absolutely inexperienced operators without any danger of the fingers being burned upon the insertion of such fuse into the conventional clips. A further object is to provide a fuse which incorporates construction eliminating the necessity for fuse switches, in that the fuse itself incorporates a switch feed.

FOOT OPERATED SWITCH.—J. C. ROUNDBACK, 2232 3rd Ave., New York, N. Y. The invention relates to an alarm system for jewelry merchants and other storekeepers when a store is "held up." The object is to provide a form of switch which may be conveniently and unnoticeably operated by a person at any point in the rear of the counter, even though such person's hands may be held above his head, a slight pressure of the body creating a closing of the circuit and the sounding of the alarm at any desired point.

Of Interest to Farmers

GAITING STRAP.—M. P. MCCARTHY, c/o F. W. Murphy, Poughkeepsie, N. Y. The invention is more particularly to harness parts known as gaiting straps used in training horses. Primarily it is the object of the invention to provide means for facilitating the breaking and training of young horses to handle themselves properly in the shafts of the trotting sulky, and to provide means for restraining the horse from side movements or lateral trotting movements.

COTTON SEED CUTTER.—W. R. PINCKNEY, 5305 W. Yon St., Little Rock, Ark. This invention relates to an appliance for cutting cotton seeds and the like for the purpose of grading and testing the same in order to determine the quality and market value of the seed. The object is to provide a device by which twenty-five seeds can be opened at one operation and the meats exposed for examination, thus shortening the time required for the grading of the seeds by one-half.

INCUBATOR.—J. B. GLOVER, Mattoon, Ill. The object of the invention is to provide mechanism in connection with incubators for providing uniform heat for the eggs, together with means for regulating the same to prevent overheating. The incubator is well ventilated and there is provided a continual circulation of water. All the joints of the heater are on the top where they are easily accessible for repair, and where in the case of leakage there will be no dripping on the eggs.

CREAM REMOVER.—J. H. COURNYER, Oskaloosa, Iowa. The invention has for its object to provide a siphon cream remover, comprising intake and outlet tubes, a cup detachably connected with the intake tube, having an internal groove, said cup constraining the cream to flow into the cup from above, a cleaning plunger movable through the intake tube, the bottom of the cup being spaced far enough below the bottom of the intake to receive the plunger and permit the entrance of cream when the plunger is in lowermost position.

Of General Interest

POURING SPOUT.—H. L. STRONGSON, 147 W. Broadway, New York, N. Y. The invention relates more particularly to a device which may be applied to a sealed tin or applied to any form of can which contains liquids to be decanted for the purpose of pouring the liquid from the can through a specially prepared spout and kept covered by a closure cap. An object is to provide the pouring spout with a cutting blade so that it may be quickly inserted in the can and clamped thereto.

COLORED DESIGN AND PROCESS OF PRODUCING THE SAME.—R. D. DONER, c/o Huron College, Huron, S. Dak. An object of the invention is to provide a process by means of which articles such as jewelry, signs, articles having decorative borders, etc., may be provided with colored designs without the use of paints, pigments, enamels, or any other means of coloring in which the color is actually applied to the design. A further object is to provide designs in which color is obtained by diffraction.

CAMERA ATTACHMENT.—E. PIERI, 147 Bleecker St., New York, N. Y. It is the object of this invention to provide means for operating a lens shutter and igniting the flash light powder, used for lighting the subject simultaneously by means of electricity. The attachment for this purpose including an actuator and a switch with contact points, said contact points being in circuit with a spark producing element, whereby upon the actuator being operated the circuit will be closed and a spark produced.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. The object of the invention is to provide an alloy especially designed as a special acid resisting metal at high temperatures and also as a high temperature metal. The alloy contains the following metals in substantially the following proportions: Copper 50-60 per cent, nickel 28-36 per cent, zinc 4-8 per cent, iron 4-8 per cent.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. The invention has for its object to provide an alloy especially designed for the manufacture of hose connections, valves, and fittings, particularly such as are used in handling gasoline and lighter distillates of petroleum. Another object is to provide an alloy not liable to cut or "wire draw." The alloy consists of the following metals: Lead 10-14 per cent, copper 55-65 per cent, nickel 6-11 per cent, and zinc 14-18 per cent.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. The object is to produce an alloy more especially designed as a high temperature metal capable of being manufactured into bolts, fittings and other articles subjected to high temperatures. Another object is to provide an alloy capable of withstanding the corrosive action of boiling concentrated or dilute sulfuric acid. The alloy will also resist tartaric and citric acids. This alloy consists of the following: Iron 16-20 per cent, chromium 5-7 per cent, copper 31-38 per cent, nickel 38-46 per cent, manganese ¼-¾ per cent.

HAIR CURLER.—A. V. P. MARTIN, 944 Gravesend Ave., Brooklyn, N. Y. This invention has for its object to provide an improved hair curler formed of a comparatively stiff, open frame and arranged to enable the user to readily curl a strand of hair around one of the members of the curler and then securely fasten the curled strand in position. Another object is to enable the user to readily open or close the curler without danger of its parts becoming entangled in the hair, or the hair breaking in the operation. The device is so constructed that it is simple and durable, and may be formed either as a hair curler or weaver, or as a "barette."

PASTE DISPENSING DEVICE.—S. L. HARWOOD, Uniontown, Ala. The invention relates to paste dispensing device which will receive any ordinary paste tube of proper size and thread and which can be operated to eject the paste in the desired quantity. The device is primarily intended for tooth paste, shaving soap, and similar material, and will economize material in that it will insure an almost complete emptying of the tube, at the same time protecting the tube.

EYE SHIELD FOR AUTOMOBILE DRIVERS.—J. F. KEITZ, 908 Summit Ave., Jersey City, N. J. An object of the invention is to provide eye shields so supported as to be out of the normal or straight-ahead line of vision and so arranged that a slight movement of the head will serve to bring the eye shields into the oblique lines of vision and thereby be disposed between the eyes of the wearer and the lights of an automobile facing in the opposite direction. A further object is to provide means whereby the right and left shields may be varied to suit the wearer's eyes.

PROCESS AND COMPOSITION FOR THE PROTECTION OF MONETARY AND OTHER DOCUMENTS.—D. N. CARVALHO, 17 W. 10th St., New York, N. Y. The invention relates to means for the protection of negotiable and other papers, and has reference to a substance which may be rubbed over the writing and after such treatment it will be impossible for said writing to be erased or fraudulently changed in any way without permanent injury to the writing. The composition is translucent so that the writing may be seen just as distinctly as before treated.

TOOTHBRUSH.—MATILDA MUELLER, c/o Louis Fitzing, R.R. No. 2, Walkerton, Ont., Canada. The object of the invention is to provide a toothbrush having separate brush backs with bristles thereon so disposed as to be positioned for simultaneously cleaning a row of teeth at a side surface and crown surface, the brush being adapted to be rocked about the general longitudinal axis thereof to position the brush for cleaning the inner or outer side of the teeth with the crown.

COMBINATION KEY.—F. CLARK, address R. A. Day & Co., Apt. 91 Bio, Mexico City, Mexico. This invention relates to a key particularly adapted for use in combination with a lock which may be set to correspond with the setting of the combination key. Another object is to provide a construction in which the various wards are of substantially the same construction, there being provided an adjusting means whereby the relative effective functioning parts may be readily and conveniently varied and adjusted throughout a wide range of settings.

SNAP FOR BRACELETS.—W. MAGUIRE and A. BAUSCH, address Albert Bausch, 100 Maiden Lane, New York, N. Y. Among the objects of the invention is to provide a snap fastener for flexible bracelets in which interlocking hooks are provided having overhanging members whereby the hooks must pass each other and then come back to a locked position, thus assuring a positive interlocking action which will remain closed under any and all conditions except the usual opening action.

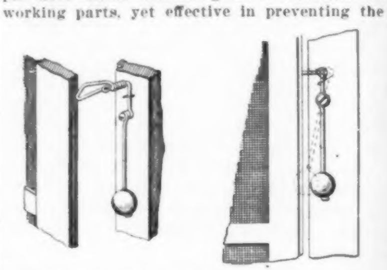
BUILDING CONSTRUCTION.—C. J. ASCHAUER, 224 Citizens Title and Trust Bldg., Decatur, Ill. The general object of the invention is to provide a method of building substantially fireproof residences at no increased cost over the ordinary methods of construction and in which pre-cast wall block units are employed and constitute mold elements for reinforced run-in-place posts and beams, making it possible to build a reinforced, concrete skeleton type of construction without the use of wood forms.

HAIRPIN.—L. H. KRICKEL, 300 S. Grand St., Monroe, La. The invention has for its object to provide a hairpin which is simple in construction and convenient to use, and which when engaging with the hair will be held against accidental displacement, the pin having a positive lock for firmly gripping the hair to hold the pin in place, and wherein the head of the pin may be of ornamental construction.

KNOCKDOWN CRATE OR BOX.—J. L. WEBER, 407 S. Clinton St., Chicago, Ill. An object of the invention is to provide a collapsible crate, which can be set up or folded easily, and which will occupy but small space when folded, having sides and a partition which may be swung parallel to the top and bottom when the crate is folded and which not only perform their obvious functions when the crate is set up but also maintains the same in its set up or operative position.

Hardware and Tools

DOOR CHECK.—MCG. E. TATE and R. M. TATE, Somerset, Ky. Among the objects of this invention is to provide a cheap and simple door check consisting of a minimum of working parts, yet effective in preventing the

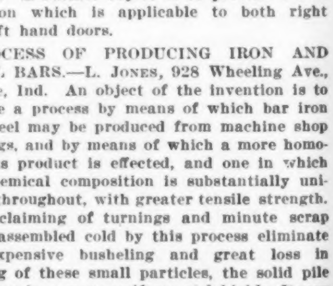


A PORTION OF A DOOR AND JAMB SHOWING CHECK AS APPLIED

jar and noise occasioned by the slamming of a door. A further object is to provide a construction which is applicable to both right and left hand doors.

PROCESS OF PRODUCING IRON AND STEEL BARS.—L. JONES, 928 Wheeling Ave., Muncie, Ind. An object of the invention is to provide a process by means of which bar iron and steel may be produced from machine shop turnings, and by means of which a more homogeneous product is effected, and one in which the chemical composition is substantially uniform throughout, with greater tensile strength. The reclaiming of turnings and minute scrap being assembled cold by this process eliminate the expensive busheling and great loss in heating of these small particles, the solid pile resulting in a more uniform and highly fibrous bar.

STORM WINDOW FASTENER.—C. R. SIBLEY, 9 City Hall Sq., Lynn, Mass. The invention relates generally to sash fasteners, and more particularly to storm windows, the object being to provide a simple arrangement whereby storm windows and the like may be readily and quickly fastened, and securely



A VERTICAL SECTION OF THE DEVICE AS APPLIED

held within sash or window frames without the necessity of screwing or otherwise more or less permanently setting the fasteners.

SHOVEL.—W. S. DECAMP, 151 W. Mulberry St., Chillicothe, Ohio. The invention has for its object to provide a shovel with means for registering the strokes, controlled by the

(Continued on page 18)

Where Is That Rattle?

(Continued from page 15)

sonably quiet until there is fluctuation in the power application under which condition the worn parts rattle to some extent and produce noise. A very annoying squeaking noise that is heard sometimes when the clutch is released is due to an insufficiently lubricated clutch spigot-bearing or a dry or worn-out bearing used in the clutch throw-out. Sometimes rollers are used to bear against the clutch throw-out collar and on one very popular make of car, if lubrication of these rollers is neglected, they will rattle and squeak in a very irritating manner.

If the trouble in the gear box is due to depreciation of the bearings on either the main shaft or the lay shaft, one will notice a certain amount of rattling all the while the car is operated. Anti-friction bearings of either the ball or roller type, if one of the rolling elements is broken or if an inner or outer bearing race ring is cracked, will produce a constantly recurring noise which can be best identified as a "clicking" sound. A flaked ball or roller causes an intermittent clicking noise and particles of metal, such as broken gear tooth edges resulting from careless gear shifting, may cause a distinctly annoying and hard-to-locate click which occurs only at intermittent intervals when the pieces pass between the gears. A poor adjustment of the driving gears in the rear axle is indicated by a grinding noise and this may be the result of the gears meshing too deeply or not meshing deeply enough. The only remedy for a noisy rear axle is to keep the gears properly adjusted and to be sure they are in good condition and also to keep an ample supply of grease in the differential housing.

By far the greater number of automobile noises are due to the automobile chassis or body. Any looseness in the multiplicity of links and shackles will cause rattling noises. In making an inspection it is well to start at the front of the car. The first thing to do is to make sure that the license tag and the lamps and lamp-supporting brackets are secure. A lamp glass or lens which is loose in the door frame will make a rattling noise all the time the car is running. Packing material in the form of candle wicking or strips of felt may be placed between the lamp glass and its metal frame to prevent this movement. The radiator retention bolts should be checked over to make sure that the radiator is firmly held. Examine the mud-guard supporting irons and also the points where these are attached to the frame. When the cooling fan runs on plain bearings it is important to lubricate these frequently because an annoying squeak will be noticed if they are dry. The looseness of any of the main components of the car relative to the frame, such as engine, transmission case or body, will result in a pronounced noise, though this will be of an intermittent character and only noticed when the car is run over rough roads. The front wheels should be checked over to see that they are properly adjusted and any looseness in the various link joints of the steering mechanism will cause rattling.

One of the most common causes of a squeaking noise is a dry spring. The spring leaves should move freely one over the other all the while that the vehicle is in use, and it will be evident that any rust or lack of oil between the springs that will interfere with this free movement will produce noise because of the friction of the dry metal parts. The motorist who lubricates his springs properly removes one of the main causes of squeaking in an automobile and also maintains the easy riding qualities of the car. The spring shackles and the shackle bolts will wear and cause noise. These are points that are very often neglected because those at the rear end of the front spring and at the front end of the rear spring are usually inaccessible and apt to be neglected by the motorist. When running on rough roads the car frame and load is continually shifted by being thrown upward whenever the wheels go over a bump or down into a hollow and as this motion is transmitted to the worn shackles noise is apparent.

A number of creaking and squeaking sounds are produced by looseness of various members of the body or its auxiliary parts and most of this noise is caused by two pieces rubbing together which should be in fixed relation to each other. When the car is assembled at the factory it is the custom to interpose felt strips or leather pieces between the frame side members and the bottom of the body sills. After the car is in operation for a time these packing materials bed down and the body will rub on such parts of the metal frame that the flattened padding permits it to come into contact with. When the retaining bolts that hold the body to the frame are loose a slight movement of the body is permitted whenever the car goes around a curve or whenever it is operated over bumpy roads. Even though the degree of motion is slight, it is all that is needed to produce a squeaking or creaking that can be readily distinguished. Squeaks are also caused by poorly fitting doors and in a closed body, rattling and squeaking may be the result of window sashes which do not fit the window frames accurately. Sometimes a door will become loose in the body side member and will rattle because it does not fit the frame properly. Noise resulting from this cause may be remedied by using packing strips or small pads of rubber or other material that will fill the space between the frame and the door when the door is closed.

Even the windshield may produce a creaking sound and this usually happens because the nuts on the supporting posts have become loose under the cowl. Other body parts that can cause intermittent noise are the mud-guards, the running-boards and side aprons. On some moderate priced and all cheap cars, the metal of which the fenders and aprons are made is of light gage. In order to economize on supporting brackets the makers of these cars do not support the thin sheet metal any more than is necessary to have in stay in place on the car. The unsupported metal produces a constant drumming or rattling noise because it acts as a diaphragm which vibrates in synchronism with the engine at certain critical speeds. This noise can be prevented by reinforcing the thin metal with strips of wood or metal riveted or bolted to the offending section and attaching the end to frame members or on supporting brackets.

If the top is not held securely at the front end of the car where it is attached to ball ends on the windshield supporting posts a rattling or knocking noise will be evident. Wing nuts are generally used at this point and when these are tightened only with the fingers a slight loosening takes place that will soon produce noise. If they are tightened with a wrench or pliers, one is reasonably sure that they will not loosen. An engine bonnet or hood that does not fit well will cause both rattling and squeaking sounds. The hood side retention clamps should hold that member firmly in position and strips of rawhide or textile packing should be placed between the hood and the ledges on the radiator and the cowl of the body on which the hood rests. Most cars are now provided with material of this nature, which is threaded back and forth through a series of holes in the supporting ledges. If for any reason the laces should break or become flattened out so that the metal parts would come in contact it is a relatively simple matter to install a new piece.

Sometimes the glass of the wind-shield becomes loose in the frame and will move slightly all the time the car is running.

(Continued on page 19)

RECENTLY PATENTED INVENTIONS

(*Continued from page 16*)

lifting of the loaded shovel. The shovel having a scoop and a handle, a counter carried by the handle, a trigger associated with the handle rod operatively connected with the counter for actuating the same, a spring holding the rod at one limit of its movement, and a lug on the trigger having an inclined surface engaging the free end of the rod.

LOCK.—V. ZIMMERMANN, address Julius Strauss, 100 W. 31st St., New York, N. Y. The primary object of the invention is to provide a lock in which the latch is mounted normally free to be manipulated for opening and closing the door under ordinary conditions, and also to provide a key controlled bolt that is normally maintained inactive, but which may be released by the key and actuated by a manipulating means to active position, locking the door.

PIPE WRENCH.—J. H. HALL, R.F.D. No. 5, Rupert, Idaho. The object of this invention is to provide a wrench especially adapted for grasping cylindrical objects, wherein handle members are pivotally connected and provided with gripping heads, the heads being normally spring pressed away from each other, one of the heads having a movable gripping jaw so mounted that it is moved inwardly in one direction, and outwardly by the other direction.

TUBE CLEANER.—F. ZLATNIK, P. O. Box 835, Miami, Arizona. The invention relates to tube cleaners in which there is a tubular body to be thrust into the tube and turned, this tubular body carrying scrapers mounted loosely and movable within certain limits for enabling them to adjust themselves to the irregularities of the inner surface of the tube, and means for providing hydraulic pressure for forcing the blades radially outward.

RADIATOR STAND.—A. A. WORZEN, Brownsville, Pa. The object of the invention is to provide a stand of the character specified adapted to be connected with a stand, work bench or the like for grasping and holding a radiator in such position that every part of the radiator is accessible, and which is capable of adjustment to bring every part into position to be worked upon.

BAND SAW.—M. H. MCCORMICK, Benford, Polk County, Texas. The invention relates to saws for sawing lumber and other purposes, and has reference more particularly to a saw in which the band is reinforced at the gullet separating the saw teeth. An object is to produce a simple and efficient band saw which can be inexpensively produced which will not readily crack or otherwise deteriorate in use, and which is capable of long and hard service.

Heating and Lighting

TRAP.—H. W. JUSTUS, Napanoch, N. Y. The invention relates to a trap for water of condensation in any steam system, an object being to provide means for automatically discharging the water when it reaches a predetermined level, the operation being controlled by the pressure of water upon a diaphragm causing the opening of a valve, and then automatically closing the valve when the level of water falls to a predetermined point.

Machines and Mechanical Devices

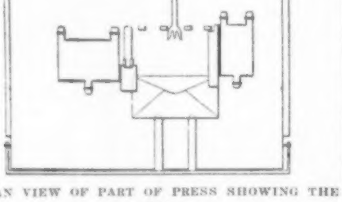
HOISTING MECHANISM.—M. L. SENDERLING, 333 Fairmount Ave., Jersey City, N. J. Among the principal objects which the present invention has in view are to secure a rotative center in close proximity to the part to be fitted, to increase the efficiency in the power applied, to simplify the mechanism, to regulate the power in correspondence with the work performed, and to reduce the height of vehicle to facilitate the loading thereof.

APPARATUS FOR WASHING CROCKERY, CUTLERY AND THE LIKE.—A. KAMMERMANN, 12,929 Superior Ave., Cleveland, Ohio. The object of the invention is to provide a washing apparatus for use in hotels, restaurants and live places where various utensils have to be washed quickly and effectively, and which will preferably in addition deliver them in a dry state ready for use without it being necessary for any person to come in contact with the water.

MACHINE FOR OPERATING ON WOOD STRIPS.—G. O. P. KUNICKE, P. O. Box 385, Dunellen, N. J. This invention relates more particularly to a machine for performing certain operations on the wood strips entering into the pneumatics of player pianos. The invention has for its object to provide a machine which will automatically groove the strips at the side edges to accommodate the material of the bellows, and puncture one of the strips to receive screws.

CONVEYOR.—D. W. STARKEY, 5719 Race Ave., Chicago, Ill. An object of this invention is to provide a conveying device which may be run economically due to the fact that one or more buckets or carriers may be provided. A further object is to provide a conveyor having means for removing material from a pile periodically as the conveyor passes the pile, the material being forced on to the carrier, and the carrier being provided with wheels which are outside of the range of the material.

ATTACHMENT FOR PLATEN PRESSES.—W. W. COFFEE, 244 Washington St., Atlanta, Ga. The invention has for its object to provide an attachment especially adapted for use with platen presses equipped with Miller



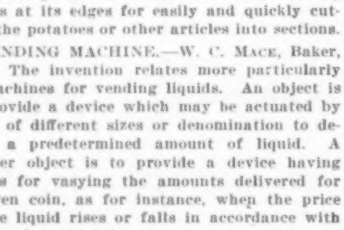
A PLAN VIEW OF PART OF PRESS SHOWING THE ATTACHMENT

feeders for converting the press into an envelop press; the device comprises a pair of clips having lugs for engaging slits in the tympan to hold the clips in place said clips being adapted to be spaced apart less than the length of an envelop.

CUTTING MACHINE.—W. C. WALLER, Wiggins, Miss. This invention relates more particularly to machines designed for cutting potatoes, an object of the invention being to provide a construction and arrangement of rotary drums carrying radially projecting knives and coöperating with a fixed cutter blade having knives at its edges for easily and quickly cutting the potatoes or other articles into sections.

VENDING MACHINE.—W. C. MACE, Baker, Ore. The invention relates more particularly to machines for vending liquids. An object is to provide a device which may be actuated by coins of different sizes or denomination to deliver a predetermined amount of liquid. A further object is to provide a device having means for varying the amounts delivered for a given coin, as for instance, when the price of the liquid rises or falls in accordance with the market quotations.

ADJUSTABLE FLEXIBLE BELT FASTENER.—J. B. MCGRORY, 46 Washington St., Norwich, Conn. The invention relates to a fastener adapted to be arranged at the ends of a belt, whereby the ends may be readily con-



A PLAN VIEW SHOWING THE APPLICATION OF THE FASTENER

nected and the belt shortened by cutting off the desired lengths, leaving a plurality of links secured on the belt and properly placed so that they form a plurality of rows to permit a pin to pass transversely of the belt through suitable eyelets carried by the links.

PATTERN LATHE.—F. NUESKE, 116 Walker St., New York, N. Y. An object of the invention is to provide means for reciprocating a pattern and the work held in engagement respectively with a fixed pattern disk and a rotary cutter so that the work will be shaped by the cutter in accordance with the pattern. A further object is to provide means for mounting the work and the pattern, and means for spring pressing a pattern against a fixed pattern disk and the work against a rotary cutter during their reciprocating movement.

STAMPING MACHINE.—H. LASKO, 710 E. 14th St., New York, N. Y. The invention relates to a machine by means of which articles such as fountain pens may have imprinted on their outer surface the name of the purchaser or any other subject matter desired. A further object is the provision of a machine which is not limited alone to stamping upon fountain pens, but is adaptable to other objects such as pencils of any size.

GAS ENERGY CONTROL HEAD FOR OIL WELLS.—E. V. CROWELL, Box 611, Tulsa, Okla. The object of the invention is to provide mechanism for utilizing in the most efficient manner the gas energy in or present with oil, by a more even distribution of the use of the gas with respect to the volume of oil raised, and effecting a more even flow of the oil, eliminating agitation of the oil to a great extent.

Musical Devices

REPRODUCER FOR TALKING MACHINES.—J. W. KAUFMANN, 1730 N. Monroe St., Baltimore, Md. This invention has for its object to provide a connection between the needle and the diaphragm controlling lever which will eliminate the usual rigidity between these parts and which will intensify the movement of the needle during its transmission to the diaphragm.

Prime Movers and Their Accessories

SPARK PLUG.—A. A. WELLS, 42 High St., E., Detroit, Mich. The invention has reference more particularly to what are commonly termed spark plugs used in connection with the jump spark ignition system of internal combustion engines. Primarily the object is to provide a spark plug in which the working parts may be removed from the engine cylinder independent of the outer shell for the purpose of cleaning the same, as well as to enable new parts to be inserted.

INTERNAL COMBUSTION ENGINE.—B. S. WILLIAMS, 416 Deaderick St., Nashville, Tenn. An object of the invention is to provide a valve actuating means for internal combustion engines, the arrangement of the rocker, valve and push rod being such that friction is materially reduced in operation, by virtue of the provision of knife edges and corresponding bearing sockets which contain oil.

Railways and Their Accessories

RAILWAY TRACK CROSSING.—B. G. VAN DYKE, JR., 1193 Hamilton Blvd., Detroit, Mich. An object of the invention is the provision of a crossing comprised of movable rail sections which are capable of occupying one extreme position in which they provide gaps to form a clearance for the wheel-flanges of a car, and another extreme position in which they provide an unbroken rail surface for the passage of a wheel thereover without the incident jars and bumps which occur in crossings of the ordinary construction.

STAKE POCKET FOR LOGGING CARS.—A. D. ADAMS, 2226 18th St., Gulfport, Miss. This invention has for its object to provide a pocket especially adapted for receiving the stakes of logging cars wherein a channel-shaped pocket is provided, having a keeper permanently connected to one side of the pocket and detachably connected with the other side and normally held connected by releasable trip mechanism, capable of being operated simultaneously for all the stakes of one side of the car, from the opposite side of the car.

Pertaining to Recreation

AMUSEMENT APPARATUS.—C. HERMANN, address Eccentric Ferris Wheel Amusement Co., 456 E. 141st St., New York, N. Y. The primary object of the invention is to provide a ferris wheel which embodies some of the features of a gravity railway. The invention provides a wheel on which some of the passenger carriages are adapted to revolve around the axis of the wheel in fixed position at predetermined intervals around the circumference of the wheel, and other carriages adapted to travel by gravity through a defined irregular path of movement.

TOY ROCKER CARRIAGE.—F. HUMPHREYVILLE, Chester Inn, Atlantic City, N. J. This invention relates to wheel toys and has particular reference to a toy which may be used by children either as a carriage or as a rocker. The frame and rockers of the device when used as a carriage are raised from the ground, and are supported by wheels which are adjustable.

DOLL WALKING DEVICE.—G. H. WILLIAMSON, 1211 W. 103rd St., Chicago, Ill. An object of the invention is to provide a device by means of which a doll may be supported and the feet caused to reciprocate in a manner which closely simulates walking. A further object is to provide a device which will support the doll in an upright position when left standing.

Pertaining to Vehicles

AUTOMOBILE LOCK.—C. GERBEN, address Thos. E. Shea, Woolworth Bldg., New York, N. Y. An object of the invention is to provide an automobile lock which will lock the foot pedals of an automobile in an extreme position so that the clutch will be disengaged and the brake will be engaged. Another object is to provide a lock which will absolutely prevent the theft of an automobile provided with the device.

GEAR SHIFT.—G. L. BROCK, West Point, Miss. The invention relates to gear shifts for general use but especially applicable to automobiles. The invention comprehends a tank for compressed air and a number of cylinders controllable by pressure of air supplied from the tank, together with means under control of the operator for distributing the air into the different cylinders, also indicating means controllable by air pressure for disclosing to the operator the particular air cylinder which is in action.

FRICTION TRANSMISSION. — G. L. JACQUES, Neillsville, Wis. The particular object of the invention is to provide a device with means to propel any vehicle and to provide transmission of friction mechanism from the motor to the drive wheels of the automobile truck, tractor or the like. A further object is to provide a means for reversing the drive, and altering the speed at will without the use of a clutch.

MUD GUARD.—E. L. TOMLINSON, North Branch, Mich. This invention relates to a mud guard adapted for use on Ford cars; an object is to provide a guard which acts as a shield to prevent the throw of mud against

DIAGRAM SHOWING GUARD IN USE

the radiator by the wheels. A further object is to provide a mud guard secured to the ordinary guards of the car and extending across the front of the car at the lower portion of the radiator.

SHOCK ABSORBER.—H. SMITH and L. LE R. CARPENTER, Amoret, Mo. This invention has for its object to provide mechanism of the character specified adapted to be arranged between the springs of a vehicle and the axle for cushioning and supplementing the action of the spring, and especially designed for cushioning the upward movement of the body with respect to the axle.

SPRING CONTROLLER.—T. S. HOWE, 2717 E. 12th St., Kansas City, Mo. The invention has for its object to provide a simple device for neutralizing the rebound of the spring, wherein the controller is arranged to assist in cushioning the downward movement of the body of the vehicle and to hold the same on the rebound at either or both ends, and wherein the side swaying or rocking of the vehicle is not interfered with.

WINDOW CLEANER.—A. P. BENNETT, 144 W. 37th St., New York, N. Y. The invention relates to devices for mechanically cleaning accumulations of snow, sleet, rain, mud or the like from smooth surfaces such as windows or wind shields of automobiles or other vehicles. Among the objects is to provide means that is adapted to operate independently of the driver of the vehicle without any attention on his part except to see that it is properly adjusted.

POLE DROP.—J. W. PETERSEN, 115 Hamilton St., Davenport, Iowa. The object of the invention is to provide a device of the character specified especially designed for supporting the pole of a carriage in horizontal position without any strain on the carriage when the pole is not in use, the said drop being pivoted to the pole to swing into and out of operative position.

Where Is That Rattle?

(*Continued from page 17*)

If the motion is slight it produces a squeaking noise while if there is considerable play, the glass hitting the metal sides will cause a high pitched rattle which in common with loose lamp glasses is more evident at certain critical engine speeds than at others. A very annoying squeak results from poorly fitting demountable rim retention lugs. Six of these are used on each wheel of most automobiles, making twenty-four in all, and looseness of any one of these will result in a reoccurring squeaking noise every time the wheel on which the offending lug is placed turns around. There are times when the wedge portion of the lug has worn to such an extent that there will be a squeak no matter how tightly it is screwed up. In such a case a new lug that will have wedges of the proper size to fill the space between the tire rims and the felloe of the wheel must be applied.

If the brake bands, especially those of the external brake form, are poorly adjusted or the friction linings worn considerably, rattling noise will be produced by the brakes striking the brake drums. In many cars the brakes squeak when applied. The reason for this is that particles of sand and grit have worked their way into the brake lining and they cause a loud squeak when the friction band is tightened and they bear against the metal brake drums. The only real remedy is to clean off the lining which can only be properly done with the brake bands removed. Sometimes a few drops of oil between the brake lining and the drum will cure the trouble temporarily, but if this is carelessly done the cure will be worse than the disease, because the brakes are apt to slip when applied. It is better to use kerosene for this purpose than lubricating oil.

In summing up it may be stated that most knocking and rattling noise is caused by an appreciable degree of lost motion between two members which should be in firm relation. Squeaks generally result from a limited movement of insufficiently lubricated or dry parts against each other. Loud knocks are due to the loosening of an important retention member while rattling means lost motion between parts of lesser importance.

European Automobile Design for 1921

(*Continued from page 9*)

ered moderate in price on the other side, but which would be called high-priced here, would put up with considerable rear axle noise, so the spiral-bevel-driven axles did not interest the European car maker until a demand was created by the simple action of such gearing used on American cars and its efficiency so thoroughly proven. There is also noted a growing consideration for the comfort of passengers, inasmuch as there is quite a general tendency to lengthen the wheelbase and increase the tire sizes. Another refinement that the American motorist has demanded for a number of years and which is found on all American cars as standard equipment is now being applied by some of the European manufacturers, who formerly supplied it only as an additional item at an extra cost. This is the complete electrical starting, lighting and ignition system. With the adoption of the engine-driven generator to charge the battery used for starting and lighting purposes, it is natural to see the coming of the battery-and-coil ignition; and a number of European cars are being equipped with some of the most popular American systems or with copies of them, though most makers favor the magneto which seems firmly intrenched in Europe.

Considering first the engine design, we find that the majority of new cars now making their debut in the industry are using four-cylinder types. The detachable-head construction has been previously mentioned and wherever this type of cylinder is employed we notice a tendency to cast the cylinders integrally with the upper half of the crank case and with the fly-wheel housing just as it is in American practice.

As regards valve operation, indications point to increasing popularity of the overhead valve locations and a number of new engines follow aeronautical practice in that the valves are actuated by overhead mechanism driven from the crankshaft by vertical shaft and bevel gears. The system of cam-shaft driving most popular in Europe is that using the inverted-tooth silent chain. It is said that this method appears in more engines than all the other types and possible combinations added together. In most of the engines side valves of the conventional poppet type are used. European designers are conservative and are not inclined to jump at conclusions hurriedly. Therefore, the old type of engine, which is giving good satisfaction in numerous applications, is not apt to be displaced rapidly by the newer and more efficient forms based on the experience gained in building engines for aircraft.

The situation as regards pistons appears to be the same as in years past. There seems to be no growing desire to adopt aluminum for pistons other than by those makers already favoring them. It is safe to say that most of the engine builders are using cast-iron pistons, but more care is being taken in their design so that they are not any heavier than necessary. In several instances steel pistons are noted and in one engine a combination or built-up piston of aluminum and cast-iron is employed.

In regard to the fuel feed methods employed, the American vacuum tank is growing more popular in England and is being used in France, though most of the French makers use the pressure feed system, using engine-driven air pump or exhaust pressure. A large number of the British manufacturers, especially makers of light cars, favor the gravity feed from a tank placed under the cowl, as this is now used on about sixty per cent of British cars. It has always been a European practice to carry a spare supply of gasoline in cans strapped to the running board or placed at other convenient points on the car; the universal fuel distribution system that we have in this country, where gasoline is obtained at numerous filling stations along the roadside, is not at all prevalent in Europe. There the practice is to purchase the gasoline in small cans, which are sealed at the refinery to prevent dilution or adulteration by lower grade and cheaper fuels. In order to eliminate the necessity of carrying these extra cans, some car designers have incorporated auxiliary tanks which retain a gallon or two of fuel for emergency use. This supply can only be drawn on when the operator turns on the valve shutting this tank off from the system.

Even in Europe, where the carburetor has been highly developed for years before it received much thought in this country, more attention has to be paid to carburetion of low-volatility fuels; and in this the design of inlet passages or inlet pipe heating methods has to be carefully studied. The problem of providing suitable inlet passages between cylinders and in water-jackets, increases the difficulties of casting the cylinders en bloc, but nevertheless, it is becoming general to find that smooth-wall passages with easy curves and of low resistance are sought after. Passages having rough walls retard the mixture and prevent the engine from developing its full power, and lack of pre-warming facilities makes the engine sluggish in cold weather. There is some difference of opinion as to whether it is best to heat the inlet passage through contact with the water system, or through direct contact with the exhaust manifold, though all engineers favor some system of pre-heating to insure prompt and constant evaporation.

If any evidence were needed to show that automobile design is making progress, a study of lubrication systems would furnish it. One finds that much more care is being taken, in regard both to obtaining efficient lubrication and to avoiding an excess which causes carbonization. In this respect, the scraper piston ring has played an important part and has demonstrated that it is a valuable improvement on most cars. Improvements now evident on some designs and likely to be found eventually on all cars, mainly concern the provision of suitable filters which are not liable to clog, and which at the same time can be readily removed for cleaning without necessarily draining the lubricant from the crank-case sump. It is also noted that designers are taking more trouble to see that filler spouts are placed in such a position that replenishments can be made easily without messing up the car and wasting some of the now precious lubricating oil.

There are not many changes in water-cooling methods, such crude things as leather-belt-driven and friction-drive water pumps being still noticed on cars of very good make. It is difficult to understand how the motorists continue to be satisfied with such makeshifts when it is such a simple engineering matter to design the pump as a component of the car driven by positive gearing, as is the case in practically all American cars.

The magneto ignition system is the most popular in Europe. The number of makers who have adopted battery ignition systems is remarkably small and most of these are people bringing out cars that are to be sold at moderate prices. On some cars both magneto and battery ignition are provided, just as they were in the transition period from the magneto to the battery system in this country. It does not seem reasonable that those who desire to use it should have to continue to furnish a magneto as standard equipment, or as a concession to popular opinion to bridge over the time until the motorist has been familiar with the fact that modern battery ignition systems are reliable. These can not be compared to or confused with the earlier trembler coil and puny celluloid container storage batteries that have been discarded in America for so many years, but which are still seen in small numbers abroad. In order to give successful service in the starting and lighting system a storage battery must be made substantial and of large capacity. When it is made in this way, there is no chance of failure because a battery that is substantial enough to deliver the steady current required for lighting purposes and the surging discharge required by the starting motor will certainly prove adequate to supply the minute demands of the modern battery ignition timer and non-vibrator coil.

[*The* Scientific American *does not agree with Major Pagé in his ignition viewpoints. As an illustration of the value of dual ignition, we would cite a recent experience when our battery was suddenly short-circuited so seriously that even the generator was not able to operate the lights through the battery. We did not try it, but we are very certain we should have got no spark out of that battery; all the current we had was going into the frame of our car. We naturally had no illumination to aid us in seeking out the trouble, and if we had not had the dual ignition we should certainly have stayed right where we were all night. As it was, we were able to run with the magneto as though nothing had happened, and to dispense with our lights by sitting on the tail of the first passing car. We do not know any good reason why the slight additional cost of the magneto should lead to the elimination of this admirable safeguard against ignition breakdown.*—The Editor.]

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One of the things that is noted in European practice which is very much different from American practice is in the mounting of the engine and gear-box in the chassis. In most American cars these two units are joined together to form what is termed a "unit" power plant. This greatly simplifies the installation though the units are not as accessible or as quickly removed as they would be if the engine were carried as a separate unit from the change-speed gearing. The practice in the majority of English and French designs is to mount the gear-box on a special frame member or one of the cross members of the main frame, entirely distinct from the power plant, to which it is connected by a short driving shaft. About twenty per cent of the European makers have adopted the unit power plant, but the remainder follow the conventional foreign construction outlined.

In a few cars the gear-box is mounted at the front of the propeller-shaft casing or on the rear of this casing close to the axle. One point that is noted, however, is that the three-point "unit" suspension idea which originated in America is being more widely adopted in Europe even when the gear-box and engine are separate units.

A point that is a marked departure from modern American practice is that the cone clutch continues to be the most popular form, though the single plate or floating disk form is increasing in popularity. Multiple plate clutches are found only on the more expensive cars, but here again an advantage is taken from American practice and instead of using metal disks as was the case before the war with the disk assembly running in oil, the newer clutches are of the dry disk type having alternated metal faces with asbestos fabric friction surfaces.

The method of final drive known as the Hotchkiss system which includes an open propeller-shaft with a universal joint at each end and in which all of the driving and braking torque stresses are resisted by the rear springs, made some gain last year, but has not increased in popularity this year. While the completely enclosed propeller-shaft with one universal joint is found in probably fifty per cent of European cars, a modification is coming in favor known as the semi-enclosed propeller-shaft. This consists of a short coupling-shaft between the change-speed gearing and the front end of the short torque which carries the propeller-shaft proper, this being supported at the front end by a frame cross-member.

In regard to universal joints, it may be said that the fabric-disk joint is rapidly increasing in popularity and is being used in many cases where the double universal-joint, open-shaft drive is employed. The leather or fabric disk is an advantageous type to use wherever the universal joints are run open and where there is no chance for oil or grease to accumulate on the disks. It is said that British designers now favor them to the extent that one-third of British cars are equipped with them and that a number of the French designers have followed the lead established by America. The flexible-disk joint requires no lubrication and is not apt to wear unduly. Inasmuch as it is not good engineering policy to use a propeller-shaft having too great a degree of angularity, it will be observed that the leather-disk universals will be satisfactory. Where there is considerable flexure of the joint, however, the all-metal, bushed star type is firmly established, where the joint is housed in a ball at the front end of the torque tube.

The worm-gear final-drive has never been very popular in America for passenger cars. For a time a considerable number of foreign designers favored the worm-drive and it was used on very light cars as well as on the more costly creations of the designer's skill. It is said that at the present time the drive situation may be summed up by considering twenty-five per cent of English cars as worm-gear driven and twenty-six per cent employing the straight-tooth bevel-gearing. The remainder of the cars may be said to use spiral bevel-gearing; the proportion using other drives is practically negligible.

Another thing in which American practice is being little followed is in the application of both sets of brakes to drums on the rear wheels. Instead of having one set external constricting and the other set internal expanding as is the customary American practice, the majority of leading designers favor internal expanding brakes for both service and emergency use. Only ten per cent of the British cars have brakes of the external band type.

Considering the chassis suspension we find that the semi-elliptic type of spring is the most popular. On light cars the quarter-elliptic spring is considered with favor by a number of designers. The proportion given in the *Auto Car* in reviewing current European practice is that forty-nine per cent of the cars use the semi-elliptic, eighteen per cent the quarter-elliptic, full cantilever is found in nineteen per cent and fourteen per cent of the chasses employ the three-quarter elliptic type.

The disk wheel is becoming more popular, though it is gaining at the expense of wood wheels. A point upon which the European designer is to be commended is in the careful thought given to refinements of detail on those minor engineering points that are so often neglected in American cars. Such items as easily adjustable brake-rods and levers, the use of ball joints on control linkage, straight operating rods instead of bent and off-set rods as are still seen to a great extent in this country, are found. In America, ample precautions are taken to lubricate main units, but minor points are often neglected; in Europe this is seldom the case.

A number of interesting comparative charts which are reproduced from *Auto Car*, our English contemporary, will bring out the various features touched upon in the foregoing article. Everything has been worked out on the basis of the number of cars shown at the recent Olympia and White City shows, which may be considered representative of European practice inasmuch as the makers from all parts of Europe had cars on display. This comparison shows the general trend and implies that many features of American practice are now considered with more favor in Europe at the present time than they were in the days before the war. If it had not been for the large number of American cars that were used by the Allied powers, and which proved satisfactory under some conditions of operation that caused trouble to the more finely adjusted foreign cars, it is probable that we would not see the adoption of so many strictly American ideas by the more conservative European automobile engineers.

The Heavens in January, 1921

(*Continued from page 12*)

Declinations 9° 1′ 48″ south—about 8 degrees south and a little west of Alpha Hydrae. On December 17th it was observed by Van Biesbroeck at the Yerkes Observatory in 9h. 17m. 0s., 3° 10′ 7″ south, and was described as round, of the tenth magnitude, and visible in a small telescope. Its apparent motion during this interval was at the rate of nearly two degrees a day, northeastward. Since the earth, from which we view it, is moving eastward too, the comet's eastward motion must actually be fairly rapid, and it must be following an orbit with rather small inclination, and must be fairly near the earth. More cannot be said until the orbit has been computed, and until then we cannot tell whether this comet will become conspicuous.

PRINCETON UNIVERSITY OBSERVATORY.
December 19, 1920.

The Role of the Patent System in the United States

THE close association of invention and the Patent Office is indicated in the 1919 report to Congress of late Commissioner of Patents J. T. Newton: "The interdependency of industrial security and efficient performances of the functions of this bureau can only be realized by a study of that relationship and by a knowledge of the economic history of the country. It is no exaggeration to declare that the work of the civilized world is done mainly by instrumentalities which have resulted from the exercise of invention; that the energy generated by engines and devices invented since the first rumblings of the American Revolution have multiplied the power of mankind a thousandfold; and that if dependence were placed solely upon man's muscular efforts, the world in its present state could not exist. In the production of food, to give one instance, the reaper and thrasher alone have done immeasurably more to increase the supply of man's basic need than all the agencies of educational propaganda and institutional assistance together. It would be presumptuous to try to reckon the increased growth in property values due to the steam engine, the steamship, and the railroad. It would stagger the imagination to figure the added prosperity given to the world by the Bessemer process alone. In the two departments of electricity and chemistry inventions in the last 40 years have provided an increment of wealth, productivity, and comfort beyond computation. The World War in its four years of destruction expended a greater amount of energy and required for its conduct more material of manufacture than was probably liberated by mankind or fashioned by all the world's peoples from the dawn of history to the invention of the steam engine. Such efforts and such expenditures of material could only come from the processes and products of invention. It illustrates and most emphatically emphasizes the fact that invention is the special phenomena of our present time.

"It is essential to our progress as is an established government to our security, and in the race between nations that country which provides the most enlightened patent system and which fosters most the inventive spirit is bound to win. For a little contemplation given to the subject will readily convince one that no method of personal improvement, no efficiency system, no particular political reorganization, is comparably potent to the results of a great invention in increasing production—the wherewithal of industry, commerce, and welfare. No matter how the individual efficiency or the human element is increased, say 50 per cent, 100 per cent, or conceivably 200 per cent, there can not be competition with the results of invention, where a machine tended by a few men may perform the labor of hundreds, or whereby a process may perform miracles unattainable through any other agencies.

"With all our remarkable advances in knowledge, we are but at the beginning of things. There is no estimable limit to the extent of our acquirements, for we cannot begin to conceive of the actual nature of our world, of the fundamentals of our existence. There is so much to learn that no matter how far we go we have yet to traverse illimitable distances on the road to the infinite stores of complete knowledge. As our utilization of the secrets of nature is directly dependent upon how much of them we have discovered, so every advance in scientific knowledge opens up a vista of new utilizations. As invention is the channel through which science finds utilitarian expression, it is clear there are no ascertainable limitations to the advance of invention, to the benefits that may accrue to mankind through its exercise."

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